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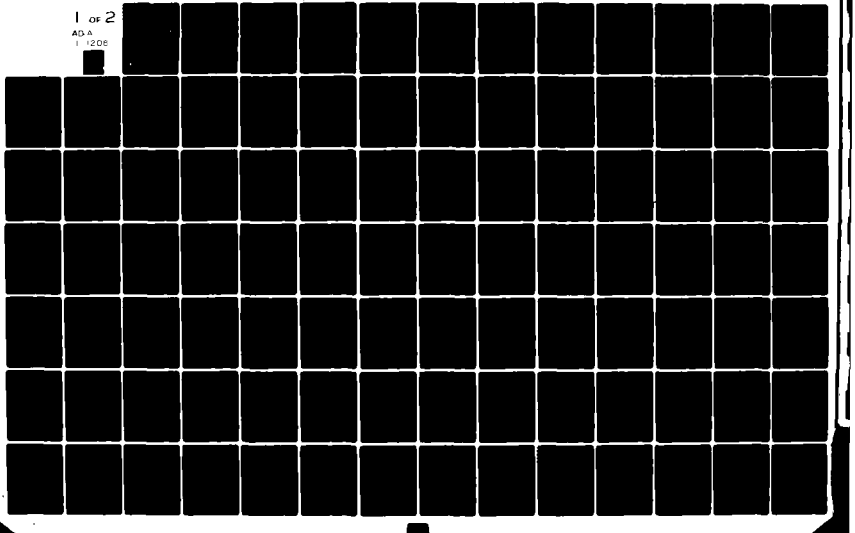

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Final Report

UNDER THE THREAT OF MT. ST. HELENS

A Study of Chronic Family Stress

Robert K. Leik
Sheila A. Leik
Knut Ekker
Gregory A. Gifford

University of Minnesota

for
Federal Emergency Management Agency, Washington, D. C. 20472
Contract No. FEMA/EMW-C-0454, Work Unit No. 2234F
Office of Prevention, National Institute of Mental Health

APPROVED FOR PUBLIC RELEASE; DISTRIBUTION UNLIMITED

FEBRUARY 1982

Executive Summary

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February, 1982

EXECUTIVE SUMMARY

This report presents the findings of a 15 month study of individual and family stress due to the eruptions of Mt. St. Helens. Two types of data gathering were used in three Washington State sites: Longview-Kelso, Yakima and Pullman. Random samples of households were interviewed by telephone about six months after the May 18, 1980 eruption (152 households in all), then re-interviewed about six months after the first interview (138 follow-up interviews). In addition, samples of families were selected for in-depth interviews in the home (60 Washington State families plus 10 control families from Minneapolis, Minnesota). Husband, wife and one teenager were interviewed separately but simultaneously, then the families participated in a computerized experimental simulation involving a worsening Mt. St. Helens scenario. Initial interviews were about six months after the May 18 eruption. One half the Washington State families were re-interviewed six months later.

Data indicate considerable stress due to the May 18 eruption, especially for those close to the mountain. Although that stress lessened in subsequent months, it increased again in Longview-Kelso in the late fall of 1980 due to predictions of massive flooding on the Cowlitz River. Levels of stress, as measured in two different ways, and a variety of coping behaviors demonstrate the emotional impact of the volcano. In addition, objective questions about losses, added expenses, health and safety problems and related experiences show the more direct impacts of the eruptions.

Many families reported personal losses or problems caused by Mt. St. Helens. Many more knew of other families with such problems. Yet most families took no action. A number did discuss evacuating and a few discussed moving permanently, but few even evacuated temporarily. Because our samples were selected from residents six months after the May 18 eruption, we did

not sample any cases who moved soon afterward. Nearly all families indicate very low probabilities that they will move in the future due to the volcano, even if it continues to erupt. In part, that reluctance is attributable to the large costs they believe to be associated with moving: economic, social, and so forth.

Additional evidence about the nature of stress over time and the process of family decision making were provided by two unusual procedures. First, a Stress Graph was developed which allows each respondent to chart subjective stress levels over extended time periods. That procedure provided a number of insights into the familial aspects of over-time stress patterns. Also, the computerized simulations required periodic family (husband, wife, teenager) discussions regarding threat from the volcano and whether the family should move elsewhere. Those discussions often brought out aspects of the family's real life concerns about and reactions to the mountain.

Field observations not related to the interviews disclosed two unanticipated problems: poor official handling of some residents' reports of earthquake activity, and the inability of local mental health clinics to attend to residents' problems related to the eruptions. Clinics in all three sites reported no change in their caseloads which could be attributable to Mt. St. Helens, but all three were working to capacity prior to May 18. That they were not involved in helping reduce widespread levels is apparently a consequence of the nature of such clinics and their already saturated schedules.

Seven recommendations follow from our results. They are

1. The Federal Emergency Management Agency, or some comparable agency, should develop appropriate information materials and public official training procedures to help residents define, confront and express their concerns during and after major

natural disasters. Every effort must be made to acknowledge rather than deny public reactions. FEMA's Mt. St. Helens Technical Information Network bulletins provided this type of information, and could serve as a prototype service. However, more attention needs to be directed to public fears and reactions.

2. An emergency expansion of local mental health services should be enabled, with administrators of those centers having explicit involvement in local emergency response plans and specific duties to provide expanded emergency services.
3. Where natural events threaten the lives of local residents, some basis for residential relocation without loss of equity must be established. Current insurance policies do not accept a need to move and an inability to sell as a basis for reimbursement.
4. Local information centers are needed in the event of such widespread hazards to provide better and more centralized information on ways to cope with the problems encountered, utilize help resources available, and so forth. People are typically reluctant to pursue such information unless it is readily available.

Regarding future research on natural hazards and how people respond to them:

5. Multiple respondent family studies are essential for understanding the complexities of family level responses. Individual respondents do not necessarily agree with other members of their households, and family decisions are not simple consensual processes.
6. More over-time data is needed, especially to distinguish the short-term, sharp response effects from longer term elevated stress problems, and to relate these problems to differential preparedness.

7. Both as a research tool and as a training basis for family preparedness, more exploration of computerized simulations is warranted.

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FEMA Review Notice

This report has been reviewed in the Federal Emergency Management Agency and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Federal Emergency Management Agency.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents results of a study of individual and family stress due to the eruptions of Mt. St. Helens, and subsequent reactions to those eruptions. Samples were selected from three Washington State sites. Both telephone surveys and in-depth family interviews were conducted, with the family interviews involving husband, wife and one teenager from each family. Following the family interviews, all three members participated in a computerized simulation experiment involving a worsening

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Mt. St. Helens scenario. Data indicate considerable stress, both by reports by objective experiences and by a new technique called a Stress Graph. Despite numerous problems, very few families evacuated at the time of the eruptions and almost none of the interview families seriously considered moving away from the volcano's threat. However, effects show consistent relationships to distance from the volcano. Seven policy recommendations are included.

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PREFACE

This work represents a prime example of cooperative endeavor enabling relatively rapid response of a research team to a major event: the eruption of Mt. St. Helens. Slightly over four months elapsed between the main eruption on May 18 and the beginning of field work. That is a short time, by normal funding standards. During that time we obtained funding, arranged a field work subcontract, developed necessary tools and modified existing computer programs to enable a "mobile" simulation experiment.

All that work, plus a successful completion of the project on schedule and within budget, would not have been possible without a great deal of help from many people. As always, James Kerr of the Federal Emergency Management Agency made our work as easy as possible. FEMA's Mt. St. Helens Technical Information Network bulletins provided valuable background information as we prepared and conducted our research. Dr. Thomas Plaut and Dr. Penny Maza from the Office of Prevention, National Institute of Mental Health, provided invaluable assistance in obtaining funding as well as helpful suggestions regarding field procedures. Such delightful people make working with federal agencies a joy.

Our subcontractor at Washington State University was Professor Irving Tallman. He, with extensive help from Professor Louis Gray, hired and trained the field staff, and oversaw the data gathering for the three sites in Washington State. They also struggled with volcanic ash in mobile microcomputers, hazardous driving on mountain highways, and myriad other problems never mentioned in research textbooks.

No project succeeds without a strong support staff. Project secretary Kristen Trelles deserves special mention for keeping everything together. As in the earlier "Natural Hazards" project, she demonstrated far more than secretarial skill, adding insights to our analyses and integration to our

efforts. Mary Ann Beneke, Executive Secretary of the Family Study Center, assisted in maintaining financial records and processing endless employee forms. Rita Koontz, Administrative Assistant for the Social Research Center at Washington State University, provided counterpart services for the subcontract. To all these people, we are most grateful.

For our own parts in the project, Sheila Leik acted as coordinator between the head office and the subcontractor, and also took major responsibility for data preparation. Gregory Gifford and Knut Ekker shared responsibilities for developing the simulation experiment software, conducting Minneapolis interviews and experiments, and processing all data. Robert Leik, as principal investigator, was primarily responsible for design of the project and decisions about data analyses, as well as drafting this report. Lest this division of labor suggest disparate activities, however, it should be stressed that all of us worked on design, helped develop tools and procedures, worked over data and edited the report. It has been very much a team effort.

We have found this project exciting throughout even though exasperating at times. To our knowledge, it represents a "first" for computerized simulation experiments in the field accompanying in-depth interviews. It also introduces a new technique called the Stress Graph. Both aspects enliven the research with new insights and promise considerable benefits for future research. We hope the report conveys our conviction that we have learned a good deal about families under stress from a volcano.

Chapter One

FAMILIES UNDER THREAT OF A VOLCANO

BACKGROUND OF THE STUDY

Since March 27, 1980, Mt. St. Helens in Washington State has become a major force in the environment of people living within hundreds of miles of the volcano. More than once, people living close to the mountain have had to evacuate their houses, and some have chosen to move permanently. It has been estimated that 53 people lost their lives. For families living from Portland to Seattle and from Astoria to Spokane, there lurks a continual threat to safety and livelihood. The research reported here focuses on the family stresses resulting from the day-to-day confrontation of that threat, and the conflict it poses between such values as home and job versus safety and health.

There has been no lack of research focused on Mt. St. Helens. Nearly every aspect of volcanic activity and its consequences has been studied, including both medical and mental health of people affected by the eruptions. Little of that research, however, has been concerned with the families threatened by future eruptions. Family stress is interpersonal as well as individual. Circumstances which make maintaining the family in its present location and lifestyle more dangerous, more difficult, or more expensive will create tensions not only for each family member but between family members as well.

One particularly useful study reports the perceptions and attitudes of people living in three communities close to Mt. St. Helens after the mountain became active in March, but before the enormous eruption on May 18 (Greene, Perry and Lindell, 1980). Awareness of potential threats (ash, lava, flood,

explosive force) was widespread. Considerable proportions of respondents in those communities perceived relatively serious threat at that time. For example, 52 percent of respondents in Woodland expected moderate to severe damage from mudflows or floods, and 70 percent of the respondents in Cougar expected moderate to severe damage from ashfall. On the other hand, a majority of the respondents from Longview-Kelso, only 35 miles from the mountain, expected no damage or only slight damage from any source. Nevertheless, a sizeable proportion of the population around the mountain expressed concern over its awakening.

Because there is no way for people to control Mt. St. Helens, there are only two ways that families can be free of the stress of living in its shadow. The family can, through religious faith, psychological compartmentalization, familiarization, or redefinition of the problem, simply decide that there is no threat. Whether that solution is possible for many families is doubtful; the entire family would have to concur if interpersonal stresses were to be avoided. The remaining alternative is to move.

Moving the family may appear to be an easy solution to the chronic stress of living near an active volcano, but it is a most difficult solution for most families. Jobs are local commodities, and have been in short supply for many months. Friendships and support networks are built up over months and years, and are severed only with considerable stress and even trauma. Equity in property cannot be realized if no one wishes to move into the area the family wants to leave. Even such intangibles as the comfort of familiar surroundings must be sacrificed if the family moves far enough to escape the threat of a volcano. Any residential move is a source of stress to family members, even when job and property equity are not at issue. Simply

moving across town may be very upsetting to family life. When all the problems accompanying a move away from Mt. St. Helens are considered, the resultant stress may be extraordinarily high.

In short, then, the activity of Mt. St. Helens has created a serious environmental hazard for residents of a large portion of the Pacific Northwest. That hazard, in turn, undoubtedly created family stresses due to the lack of a suitable resolution of health and safety versus continuity in an accustomed style of life. It is necessary, of course, to distinguish between family stress directly attributable to the volcano and family stress due to other life events and circumstances. A high stress level could have existed prior to the volcanic activity, or it could have developed since the mountain began erupting, but for reasons that are unrelated to those eruptions. Our concern in this report will be to determine the extent to which the volcanic activity has created new stresses for families, how those stresses compare with more routine family stress, and the manner in which families affected by the mountain have attempted to cope with this new intrusion upon their lives.

The preceding statement implies two parallel areas of interest. First is the area of family stress and coping. There is an extensive literature concerning family stress and coping behavior, with parallel development in the areas of individual stress and coping. These areas relate also to more general concerns of physical and mental health. In fact, the American Psychiatric Association has added a classification of "Posttraumatic Stress Disorder" to cover a common syndrome of persons who have experienced severe stress (Horowitz et al., 1980).

The other area of relevant research and theory is that concerned with natural disasters. Although a large portion of the disaster research field

has focused on community and organizational reactions to warnings and ability to recover after disasters, there is extensive literature on how individuals and families react to and are affected by such serious events in their lives. Each of these areas will be discussed briefly.

FAMILY STRESS

Family stress theory and research originated with studies of families in the depression (Angell, 1936; Cavan and Ranck, 1938) and during war time separation (Hill, 1949). Subsequent modifications of the concepts of crisis and stress (Hill, 1958; Hansen and Hill, 1964; Burr, 1973; Pearlin and Schooler, 1978; Hansen and Johnson, 1979) have extended and elaborated the earlier work, and the concept of family coping behavior has been added (McCubbin et al., 1978; Pearlin and Schooler, 1978). Most recent theoretical statements emphasize an acute disruption of orderly existence rather than a continuing struggle with long-term problems.

Most formulations of family stress theory are based on Hill's (1949) ABCX model. The extent to which a crisis exists, X, is a product of three factors: some crisis-producing event, A, the family's resources for meeting the crisis, B, and how the family defines the event, C. The extent to which a family is vulnerable to a crisis depends upon how long the family has been able to anticipate the crisis event, the amount of change in family interaction which the event requires, the family's resources for meeting these requirements, including levels of integration and adaptability prior to the event, and the extent to which the cause of the event is seen as external to the family (see Hansen and Hill, 1964; Burr, 1973). The more ambiguous a situation is, the more stressful it is (Hansen and Johnson, 1979; Kahn, 1979; Rosow, 1976).

How well the family recovers from a crisis situation depends upon the family's prior integration and adaptability, how the family copes with the situation (i.e., how the family solves relevant problems generated by the crisis; Pearlin and Schooler, 1978), and whether the source of stress is removed. Clear community or cultural norms for coping with stress should aid family recovery, as should the family's involvement in social support groups and activities (McCubbin et al., 1978; Kahn, 1979).

This view of family stress concentrates primarily on events affecting the whole family and requiring redefinition of relevant family roles and reallocation of family resources. It is possible, however, for events pertinent to a single member of the family to have implications for family stress and stability. For example, it has been shown that law enforcement personnel have one of the most stressful jobs available (Kroes and Hurrell, 1975). Such stress is largely a consequence of the continuing dangers and frustrations of police duty, but also results from the extent to which the police role interferes with normal family existence.

Kroes, Margolies and Hurrell (1974) found that 100 percent of the officers that they interviewed stated that the job of being a policeman had negative consequences for their family life. In addition, Richard and Fell (1975) demonstrated that there is an unusually high number of "premature deaths" among police officers, unusually high hospital admissions for circulatory and digestive tract problems, and an unusual rate of suicide. Various studies have demonstrated that police tend to be workaholics, to show unusual evidence of exhaustion, to be subject to alcoholism and drug abuse beyond normal population levels, and to have severe marital problems.

The relevance of discussing police stress is to make clear that, even though events may not affect all members of a family directly, if one member

is severely affected, it is likely that the consequences are felt by all members of the family. With reference to Mt. St. Helens, one case studied in the research to be reported involved someone whose job required that he be continually on the mountain after the May 18 eruption. Although he continued to fulfill his job, he reported being in a continual state of fear for his life. It is reasonable to presume that this constant stress would have effects upon his family as well as him individually. As will be seen, we have considerable evidence of stress in the families affected by the mountain.

We will also show evidence of major differences in levels of stress felt by the same individual *at different times*, across individuals in the same family, across families in the same proximity to the mountain, and across communities at different distances from the mountain. Typical family research has not involved all of these variables in the same project and for the same respondents.

Certain aspects of family stress theory and research are particularly relevant to the study of families affected by Mt. St. Helens. First, the mountain poses a continuing threat as opposed to a single stress-producing event. The cumulation of stress may well become overwhelming even though a particular eruption might have been successfully weathered by a family. In that sense, the Mt. St. Helens experience is more like that of the police family, involving continual or chronic stress and the need to cope continually with that stress, instead of the more traditional single event leading to a crisis and eventual recovery or failure.

Secondly, the family's resources for coping with stress may have been reduced by the volcano. In particular, financial resources of many of the residents of the Pacific Northwest have been affected by the eruptions

because the economy of the area has been altered and many families have encountered unusual expenses for repair or clean-up after the eruptions. In addition, informal sources of social support, such as friends and relatives, may have been reduced as some of the population has decided to move away.

Third, because there was little time to anticipate a situation of continual threat prior to the first major eruption, it is unlikely that the affected families would have made advance plans for coping. Less than two months elapsed between the first rumbles of the mountain and the May 18 eruption. Had sufficient time been available, families may have sought employment elsewhere, tried to sell their homes, or otherwise taken steps to escape the threat.

Fourth, the amount of change which the families have had to make in order to accommodate the threat is dependent upon many factors. How far people live and work from Mt. St. Helens will determine actual physical danger and the need to move for the sake of personal safety. Employment may or may not have been seriously affected by the volcano, depending on location and type of work. Lumbering, for example, has been very seriously affected. The extent of ash fallout has altered some families' life styles more than others, especially to the extent that the outdoors is a major part of family occupation or recreation. It has been noted often, since the mountain first erupted, that many people living near it chose to live there primarily for reasons of natural beauty, peaceful surroundings, and abundant outdoor recreation opportunities in the Cascade Mountains.

Fifth, although there is no chance that the eruption of the volcano can be blamed on particular family members, it is possible that current exposure to threat may be seen by some family members as a result of other members being unwilling to move away. If the family is to remain as a unit, and one or more members refuse to leave the area, then all family members will

continue to experience potential threat from continued volcanic activity. Finally, the extent to which the family was already experiencing stress due to, for example, family life cycle transitions, occupational problems, or marital discord, can be expected to influence the family's ability to withstand the additional stress caused by the mountain.

In short, family stress theory and research raise appropriate questions regarding the specific problems of living under the threat of an active volcano. The extent to which families have experienced stress due to the mountain will depend in part upon the objective consequences of the eruptions and in part upon the family's ability to cope with those consequences. Coping, of course, may be in the form of trying to solve problems directly and eliminate or minimize future problems, or by avoiding or denying those problems. Disaster research has relevant findings about how people cope with such major stress events.

DISASTER RESEARCH

Rather than review an extensive body of research related to disasters, it is more appropriate to cite a few findings relevant to how people respond to warnings and how they recover after a disaster. More general reviews and reports can be found in Quarantelli, 1978; Burton, et al., 1978; Mileti, 1975. With reference to response to warnings, it has been shown that:

(1) people typically neither panic nor automatically respond to a warning, but act more as reasonably rational decision makers. As decision makers, they appear to follow a series of simple choices relevant to determining the need for action. If a need is perceived, and there seems to be sufficient time before action is essential, then there is likely to be a search for further evidence on which to base a reason or (subjectively) rational choice (Drabek, 1969; Perry, Lindell and Greene, 1980; Leik et al., 1981).

(2) Factors which convince people they are at risk, such as environmental clues or personal contacts from friends or officials, are more important influences on subsequent actions than are official warnings (Kunreuther, 1978; Janis and Mann, 1977).

(3) Involvement in community social networks will affect the way people respond to disasters (Drabeck and Boggs, 1968; Kendall and Clark, 1981).

(4) Families with children are most likely to display independent decision-making behavior when faced with natural disasters. Couples without children are less so, and isolated individuals are the most likely to follow official recommendations without engaging in a deliberate problem-solving process. That is, the nature of the family structure is a crucial variable in determining response behavior (Bolin and Trainer, 1978; Kendall and Clark, 1981).

For certain kinds of repetitive disasters, such as severe floods, there tends to develop a "disaster subculture" (Moore, 1964; Hannigan and Kueneman, 1978). To the extent that such a disaster subculture appears to provide effective response when the disaster occurs, there is an accompanying disinterest in preparedness for future disasters by potential victims. Thus, it might be expected that the very continuation of activity at Mt. St. Helens may have produced a sense of ability to cope and an accompanying decrease in interest in being prepared to respond to future eruptions.

Cross-cultural research has shown certain strong similarities of response to disasters, such as uniformly high priority given to seeking safe places for family members and extended duration of psychosomatic and other mental health effects of major disaster events. Three rather different modes of response to disasters have been shown by families in

different cultures, emphasizing dependence upon institutionalized support structures, kinship networks, or rather isolated and individuated family responses (Bolin and Trainer, 1978). The most common response appears to be to seek temporary shelter with relatives or friends until the most severe danger is passed, with the assumption that the family will be able to return home and to resume relatively normal life once the threat has passed.

These findings suggest that the families affected by the eruptions of Mt. St. Helens can be expected to have attempted reasonably rational solutions to the stress precipitated by those eruptions. Ash fallout, which was heavy in all areas studied, should have provided strong evidence of being at risk, although the apparent risk should depend upon distance from the volcano. Also, apparent risk should depend upon the extent to which individuals view the eruptions as over or as likely to continue.

Permanent relocation, even in the face of such a severe and continuing threat, is unlikely. Our sampling procedures ensured getting families who had not relocated, at least during the first six months after the major eruption. Extensive data available from previous studies indicate how households and families have responded to hurricanes, flash floods, and tornadoes. It will be possible, therefore, to compare family response to the chronic as well as acute stress posed by Mt. St. Helens with how other families have responded to one-time acute stress posed by other natural disasters. More than previous studies, however, the present research will attempt to determine the extent to which families, rather than just individual members, experience severe and lasting consequences of the volcano's eruptions.

Chapter Two

METHODS

The research to be reported here involves both interview and simulation-experimentation methods. Families located in four different communities at increasing distances from Mt. St. Helens were studied approximately six months after the May 18 eruption. Some interviews were conducted by telephone, with only one person answering for the whole family. Other families were interviewed in depth, with both parents and a teenager in each family being interviewed. These "in-depth" families were then involved in computerized experimental simulation of increasing threat from the mountain. Approximately six months later, all available telephone interview households were re-interviewed. Similarly, a subsample of the in-depth families was re-interviewed. This chapter will deal with the samples, the timing, measurement procedures and experimental methods used in the study.

SITES AND SAMPLES

Four communities were selected to provide a more-or-less geometric progression of distance from Mt. St. Helens. The four sites were: a) Longview-Kelso, Washington, about 35 air miles west of the volcano; b) Yakima, Washington, about 90 miles east northeast of the mountain; c) Pullman, Washington, about 250 air miles east of the mountain; and d) Minneapolis, Minnesota, about 1500 air miles east. All Washington State sites are relatively small cities. Populations are approximately: Pullman, 24,400; Yakima, 51,300; Longview-Kelso, 39,400.

These three sites were affected by the May 18 eruption and can be considered to be under some continuing risk from future eruptions. The enormous eruption on May 18 caused such heavy fallout of volcanic ash to

the north and east that Yakima had a virtual blackout for nearly 36 hours. Even Pullman received so much ash that many businesses were temporarily closed. The Yakima Valley is fruit-growing country, and the accumulated ash was believed to pose a serious threat to the year's fruit crop and possibly to crops of future years. That threat has since been seen as less problematic than originally believed. Further east is wheat-growing country, which had similar concerns after the massive fallout. Although subsequent indications are that the ash has not created the problems which were at first anticipated, there was considerable early fear that the ash posed both economic and health hazards of large magnitude.

Because of the prevailing winds at the time, the site closest to the mountain (Longview-Kelso) was less directly affected by fallout from the May 18 eruption than were the other two Washington State sites. However, that site was in the path of the cloud of ash from a second major eruption on May 25. Also, Longview-Kelso is only a few miles from Toutle, the small town which had to be evacuated because of mud and debris surging down the Toutle River. That river feeds into the Cowlitz River, which flows through the Longview-Kelso area. In addition to threat from ash or flood, the Longview-Kelso area suffered economic problems because the mountain seriously altered lumbering activities. The lumber industry is the principal industry in that area.

In sum, the three Washington State sites were strongly affected by the major eruption on May 18, and could continue to be affected by subsequent eruptions if such eruptions approach the strength of that most serious occurrence. In addition, the site of Longview-Kelso is under potential flood threat both from further activity of the mountain and from the fact that the destruction of vegetation reduced the ability of the land to control erosion and contain snow melt. In fact, in October, 1980, the Longview-

Kelso newspapers were carrying warnings of severe flood threat if normal rain and snowfall occurred in the fall and winter of that year. Fortunately, the precipitation was unusually low in the subsequent months.

The Minneapolis site is, of course, under no threat from Mt. St. Helens. A local news service had carried predictions of light ash fallout from two of the eruptions, but there was no apparent concern in the area about the effects of the volcano. A sample from Minneapolis constitutes a control sample only, rather than a sample at risk.

As will become evident in a subsequent section of this chapter, most of the information gathered from the telephone surveys would be inappropriate for households not at risk from the mountain. However, information gathered during the in-depth family interviews and the experimental simulation must be compared with some control families not at risk to be adequately interpreted. Therefore, only partial in-depth family interviews and experiments were conducted at the Minnesota site.

In consequence, two samples were drawn from each of the at-risk sites, and one from Minneapolis. Using a random digit dialing procedure, households in each of the at-risk communities were contacted to determine whether they would be willing to participate in the study. Criteria for inclusion were the presence of one or more teenage children in a two-parent household. These criteria were established in part because the concern of the study was family stress and coping with a severe stressor event, rather than individual stress and coping. By specifying both parents and one or more children in the household, we were sampling families rather than isolated individuals. The specification of teenage rather than any age child was a consequence of the requirements of the experimental simulation. As will be discussed, that simulation involved computer use on the part of the family

members, hence required both the ability to read and respond to messages and the ability to learn simple input procedures at a computer keyboard. It was assumed that children below teenage would have difficulty adapting to this task.

Because the survey sample did not involve interviewing multiple members of the same household, it would have been possible to include families with other than teenage children. However, the household telephone survey provided the basis for finding families to be studied in depth. The procedure was as follows. First, the household was contacted by random digit dialing, using only the prefix digits assigned to the selected areas. This eliminated calls outside the four sites. The person who answered the phone was asked if he or she was one of the parents of the household. If not, the interviewer asked to speak to one of the parents. It was then determined whether the household satisfied the criteria of two parents and at least one teenager. If not, the person was thanked and the interviewer terminated the telephone call. If the criteria were satisfied, the interviewer explained in considerable detail the nature of the study and its importance as well as the rights of the respondent to terminate the interview then or at any subsequent time if he or she agreed to participate.

When agreement to continue was obtained, the interviewer then explained that a subsample of the households being studied was to be selected for special in-depth study for which we would provide modest remuneration. Further information was provided about the in-depth study, and the respondent was asked whether [illegible] family would be willing to participate in this special subsample. If so, the interviewer proceeded to schedule the family for an in-home visit from the field staff. If not, the respondent was asked if the regular telephone interview could proceed at that time. In some

instances, it was necessary to call back for a more convenient time for scheduling in-home interviews, but most interviews proceeded readily from first contact.

The final household survey samples consisted of 50 households each from Pullman and Longview-Kelso, and 52 from Yakima. Thus, 152 households were interviewed by telephone. Family in-depth interviews were conducted with 20 families from each of the Washington State sites, and 10 families from Minneapolis, with three people from each family being interviewed. Each of the family members was interviewed separately but at the same time. This procedure required a team of three interviewers per family, each taking a family member to a separate room. On completion of the interviews, the family members from the in-depth sample were introduced to a microcomputer network and led through how to use the machines for the simulation experiment.

Household telephone interviews required approximately 20 to 30 minutes, whereas family interviews required up to one hour plus one-and-one-half hours for the experimental simulation. Families were paid $25 for participation, but telephone survey households were not provided remuneration. When a family agreed to participate in the in-depth study, that family was removed from the telephone survey list. Consequently, no household appears in both the telephone survey and the in-depth family interview sample.

The structure of the research design, then, provides a larger telephone survey sample as a basis for judging the representativeness of the smaller in-depth family interview sample. Because the in-depth procedures were so lengthy, it was impossible to study as many families as would be desired from a statistical representativeness point of view. By comparing the characteristics of the families studied in depth with the characteristics of the larger number of households interviewed by telephone, we will be able to assess the representativeness of the families studied in detail.

As noted above, initial interviews were conducted approximately six months after the May 18 eruption. About six months after the first interviews, a second wave of interviews was conducted. All households that could be recontacted were re-interviewed from the household survey sample. Over 90 percent of the original households were subsequently re-interviewed. One half of the families studied in depth were restudied six months later as well. The fact that only half of the in-depth families were restudied is due to the extensive time and the on-site requirements of the in-depth studies. The follow-up interviews of the in-depth families were not accompanied by a second experimental simulation, because prior familiarity with the simulation procedures would have affected a second response pattern. The entire data set, then, contains the following cases. From the household survey, there are 152 first-wave interviews and 138 follow-up interviews. From the in-depth family interviews, there are 70 three-person family first-wave interviews, hence 210 individual family-member first-wave interviews. Follow-up interviews were conducted with 30 three-person families, providing 90 individual family-member follow-up interviews. Finally, 70 three-person experimental simulation sessions were conducted in conjunction with the first-wave in-depth family interviews.

MEASUREMENT

The following types of data were gathered in both the telephone survey interviews and the in-depth family interviews, although the level of detail was considerably greater in the latter interviews. Household demographics were obtained, including age, education, occupation, and work status of all adult members of the household, plus the age and sex distribution of children in the household. The family's experiences with the eruptions of Mt. St.

Helens were assessed, and their perception of current and future risks were also measured. The extent to which the family discussed the threat from the mountain and attempted to reach a decision concerning how to respond was measured for each of four major eruptions: May 18, May 25, June 12, and July 22. Some families were asked about the October 18 eruptions as well, but many interviews were completed by that time.

The preferences of the individual members for moving or staying were assessed in the family interviews. In all interviews, any decisions the family had made regarding protective action or relocation were studied. Two approaches were used for measuring stress. First, the life events stress scale approach was used (Holmes and Rahe, 1967). Due to various criticisms of the original life events stress scales, items were selected from McCubbin's more recent FILE (Family Inventory of Life Events). Of course, life events represent standardized stressors rather than specific volcano-relevant stress. It was necessary, however, to determine the extent to which stress existed for reasons other than the volcano in order to assess the importance of the volcano in the overall stress pattern of the family.

To measure stress more specifically associated with the mountain in comparison with other types of stress, an entirely new procedure was developed, called a stress graph. Respondents in the in-depth family interviews were presented a blank graph containing a time scale on the horizontal axis and a zero-to-ten stress scale on the vertical axis. The time scale was marked in months, beginning prior to the May 18 eruption, and contained arrows indicating the five major eruptions on the dates cited above. Respondents were led carefully by the interviewer through the process of determining periods of high stress and how high that subjective stress was on a zero-to-ten basis, as well as periods of low stress. As particular stress times or periods were established, notes were made on the graph which

eventually allowed the respondent to draw a continuous curve over time, representing how that person's subjective stress varied during the period under study.

For the first interview, the period covered by the stress graph began prior to the May 18 eruption and continued to the time of interview (approximately six months). For the second interview, the time scale began with the previous interview and continued to the time of the second interview (again, approximately six months). Interviewers were instructed to make notes on the graph indicating the reason for each peak of stress and whether the mountain was relevant to that peak. Thus the stress graphs provide a continuous over-time report of perceived levels of stress and sources of stress. It is possible to compare perceived stress from the eruptions of the mountain with perceived stress from other events, as well as to ascertain any events which were unique stressors not captured by the standard inventory of life events items. The effects of unique stressors on the individual family members could also be measured by the stress graph.

In addition to stress, the manner in which people coped with the stress was also measured. Coping items were selected primarily from McCubbin's COPE instrument, with some additional items included. Coping items typically concern behaviors, such as smoking, reading, planning for the future, or participating in social gatherings. Because the main concern of the study was with the effects of the volcano, items were worded so that the respondent indicated whether a particular activity was being engaged in more than, about the same as, or less than before the May 18 eruption. Items which were not applicable (e.g., "smoking" for a nonsmoker) were so recorded. For follow-up interviews, the comparison was with the previous interview.

In addition to these types of variables, questions were asked concerning social network linkages, such as number of neighbors known, informal assistance patterns, duration of residence and so forth.

This brief overview of the variables examined provides very little detail about measurement. In part, that detail will be provided as findings are reported and specific aspects of questions and response options are discussed. If more information is needed, questionnaire forms can be made available. However, the variety of forms (survey, interview, first wave, second wave, control) and their length preclude including them in this report.

In general, the variables fall into four major groupings. The first group is family demographics, which are useful both for assessing the representativeness of the cases studied and for use as control or predictor variables in subsequent analyses. The second group of variables is derived from a variety of studies of response to natural hazards. Those variables include perception of risk, aspects of searching for further information and for validation of that perception of risk, and decisions regarding the perceived threat. A third set of variables concerns the individual and family stress and coping patterns. Finally, a set of variables about individual and family decision making comes from the simulation experiments. Those experiments will be discussed next.

SIMULATION EXPERIMENTS

After each family in the in-depth sample was interviewed, the three members of the family participated in an experimental game simulation using a microcomputer network. Initially, that computer network was housed in a motor home, so that the "mobile laboratory" could be taken directly to the family residence. For a variety of reasons, including intrusion of

volcanic ash in the computers and inadequately controlled power supplies, the computer system did not function well in the motor home. Consequently, procedures were changed so that the computer network was set up in a motel room in the city where interviews were currently being conducted, and the families were brought to that motel room for the simulation experiment portion of the research. The change in procedures appeared to have caused no difficulty for the study.

The equipment used consists of three TERAK microcomputers, each of which has its own keyboard, cathode ray tube terminal (CRT), central processor, and floppy disk. Although each terminal functions as a complete computer system, the three were connected so that messages from one computer could influence what occurred on the other computers.

Initially, subjects were shown how to use the computers and were introduced to a game involving running a small business. The game had been constructed for an earlier study of response to natural hazard warnings (see Leik, Gifford and Ekker, 1981), and was designed to be both stimulating and reasonably demanding of the person playing the game. In fact, the game is sufficiently motivating that many subjects were unwilling to quit at the end of the simulation session. Of course, a business game has little to do with Mt. St. Helens. However, at selected times, news bulletins were provided via the computer concerning hypothetical volcanic activity including, when appropriate, estimates of damage, injuries, loss of life, health problems and so forth. When eruptions occurred in the simulation, a map of Washington was displayed showing major sites, the location of the family playing the game, the location of Mt. St. Helens, and a growing spread of ash across the screen representing the area blanketed by the latest eruption. To maintain a sense of real time, a day-by-day date was

shown on the screen, with each simulation day lasting about one minute. The first date shown was in January 1981, whereas the experiments were conducted during 1980. Therefore, the simulation was presented as entirely hypothetical future behavior of the volcano.

Two kinds of response relevant to the volcano were obtained automatically by the way people played the game. First, at fairly frequent intervals, individual family members had to decide whether to continue their business operation or to close it down and take some kind of protective action against the volcanic activity. The game was so constructed that if an eruption had covered the geographic area where the family was located, difficulties with the business ensued, such as clean-up expenses and loss of productivity.

At four times during the hour-and-one-half simulation, individual family members had to decide whether they preferred to move away from the community they were then in (the actual community they lived in) in order to protect themselves and their business from further problems of the mountain. After these individual decisions were entered into the computer, the family then turned away from their computer consoles and discussed among themselves whether they as a family wished to relocate. It was required that all three members move to the same alternative site or that all three members stay at their current site. That is, they had to act as a family unit. Consequently, the family discussions provided both a vehicle for observing the manner in which the families approached the problem of whether or not to relocate and a basis for comparing the collective family process with the individual preferences obtained earlier.

Although this brief discussion cannot convey the character of the game simulation, it should be pointed out that all family members found the use of the computers comfortable and easy to learn, all members appeared to be

quite engrossed in attempting to run their business successfully, and some of the families' discussions indicated a clear relationship between their behavior in the game simulation and their real concerns and evaluations regarding the threat from Mt. St. Helens. As with the survey and interview data, more details of the experimental procedure will be provided as those data are analyzed in subsequent portions of this report.

This constitutes the entire set of procedures and measurements used in the study. Some types of variables, such as stress or family decision making, were measured in at least two ways. The majority of the variables have been used in prior studies, and some have very extensive documentation. To our knowledge, this is the only study involving both interview and game simulation methods to examine the process by which families experience and respond to a major environmental stress.

Chapter Three

THE TELEPHONE SURVEY

DEMOGRAPHICS

As indicated in the previous chapter, the first wave of telephone interviews provided 132 respondents, each representing a household in one of the three Washington State sites. Subsequent second-wave interviews were conducted with as many of those first-wave households as possible, resulting in 138 follow-up interviews for a 91 percent follow-up rate. Before examining data relevant to reaction to the volcano, it is appropriate to determine what type of families were represented in the sample. Toward that end, we will look briefly at the age distribution of each of the parents in the household, the work status of the parents, their occupations, and the composition of the households in terms of children in the family and other adults living with the parents. It will be recalled that a criterion for inclusion in the sample was that both parents and at least one teenager be present in the family.

Table 3.1 shows the ages of husbands and wives in the households studied, by site. It is apparent that most of the husbands and wives in all three samples are in the age group 30 to 49. In fact, between 72 and 82 percent of husbands and of wives in each site falls within that range. There are no obvious differences between the sites regarding ages of either spouse. Obviously, our samples do not include very young or very old families, primarily because of the criterion that at least one teenager be in the household.

Aside from teenagers, nearly half of the households contained children in the 7 to 12 year range, and a small percentage have children six years old or younger. Again there are no obvious differences by site except for the

fact that only two percent of the Pullman households have very young children, whereas 14 and 16 percent of the families in Yakima and Longview, respectively, have such very young children. Regarding other adults in the household, 15 of the 152 cases contained one other adult and four more contained at least two other adults. However, it is apparent from examining the ages of those other adults that most of them are adult children in the early 20's still living at home. The only noticeable difference by site is that the Longview households contain only one other adult, with the Pullman and Yakima households accounting equally for the balance of other adults that appear in the sample.

TABLE 3.1. Ages of Parents, by Site

	Pullman		Yakima		Longview-Kelso	
Age	Husb	Wife	Husb	Wife	Husb	Wife
20-29	0 (0)	0 (0)	0 (0)	1 (02)	0 (0)	1 (02)
30-39	11 (22)	18 (36)	18 (35)	24 (46)	18 (36)	25 (51)
40-49	25 (50)	23 (46)	21 (40)	15 (29)	18 (36)	12 (25)
50-59	10 (20)	8 (16)	10 (19)	11 (21)	13 (26)	11 (22)
60-69	3 (06)	1 (02)	3 (06)	1 (02)	1 (02)	0 (0)
70 or over	1 (02)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
No response						1
	50	50	52	52	50	50

Percent of responses shown in parentheses

Turning to the question of work status of the parents, it is apparent from Table 3.2 that the families are quite similar across sites and generally representative of U. S. families regarding parental employment. Nearly all husbands work full time, and between 52 and 65 percent of the wives work either part time or full time. Thus far, samples in all sites appear comparable and representative of the family life cycle stage that we intended to study.

TABLE 3.2. Work Status of Parents, by Site

Work Status	Pullman		Yakima		Longview-Kelso	
	Husb	Wife	Husb	Wife	Husb	Wife
Full Time	[illegible] (100)	23 (47)	44 (90)	23 (46)	44 (94)	22 (44)
Part Time	[illegible] (0)	9 (18)	2 (04)	4 (08)	1 (02)	4 (08)
Unemployed	[illegible] (0)	17 (35)	3 (06)	23 (46)	2 (04)	24 (48)
No response	2	1	3	2	3	0
	50	50	52	52	50	50

Percent of responses shown in parentheses

Occupational data indicate that, despite similarities just demonstrated, there is a major difference between Pullman and the other two sites. That difference is attributable to the fact that Pullman is primarily a university town, hence has a very high rate of professional occupations compared to most towns or cities its size. Table 3.3 indicates that 82 percent of the husbands who provided information about their occupations are either in the professional-technical or the managerial-administrative categories in Pullman, whereas the other two sites have 30 and 31 percent of husbands in those categories. Obviously, the Pullman sample is a considerably higher status sample, so it will be necessary to keep that fact in mind when interpreting differences between sites.

Unfortunately, the site differences are also related to distance from Mt. St. Helens. This may make it difficult to untangle the source of any site differences observed. However, if data on response to the volcano show reasonable progression from Longview to Yakima to Pullman (the distance gradient), rather than aburpt shift from Pullman to the other two sites, it

will be reasonable to interpret the results as a function of distance rather than of status of the households studied. It is also evident from Table 3.3 that one out of six households in the Yakima sample is involved in farming, compared to only one household in the other two sites combined. By contrast, a much larger proportion of the Longview-Kelso husbands are in the craftsman-foreman category than in either of the other two sites.

These differences reflect the different economic bases of the sites, indicating that the samples are reasonably representative of those sites but have distinct differences across sites. Regarding employment of the wives, the dominant employment category for all sites is clerical work. That is, of course, not surprising. Somewhat more of the Longview-Kelso wives who are employed are in the professional-technical category than in either other site, but most differences are small enough to be of little relevance for the

TABLE 3.3. Occupation of Parents, by Site

	Pullman		Yakima		Longview-Kelso	
Occupation	Husb	Wife	Husb	Wife	Husb	Wife
Prof/Tech	31 (65)	6 (19)	7 (15)	5 (19)	9 (20)	7 (27)
Manag/Admin	8 (17)	2 (06)	7 (15)	3 (11)	5 (11)	3 (12)
Clerical	0 (0)	18 (56)	3 (06)	11 (41)	0 (0)	10 (39)
Craft/Fore	7 (15)	4 (13)	12 (25)	2 (07)	21 (46)	0 (0)
Transport Op	1 (02)	0 (0)	3 (06)	0 (0)	3 (07)	0 (0)
Nonfarm Labor	0 (0)	0 (0)	8 (17)	3 (11)	8 (17)	5 (19)
Farmer/Farm Labor	1 (02)	0 (0)	8 (17)	2 (08)	0 (0)	0 (0)
Service	0 (0)	2 (06)	0 (0)	1 (04)	0 (0)	1 (04)
No response	2	18	4	25	4	24
	50		52	52	50	50

Percent of responses shown in parentheses

COMMUNITY INVOLVEMENT

To get an indication of the extent to which the families studied are linked to their communities, the following information was gathered: how many years the family has lived in their current home, how many years they have lived in the same area, whether or not they own their homes, how many neighbors they feel they can talk with, and how many neighbors they feel they can ask for help if they need it. None of these data show important distinctions between the sites. On the average, families have lived in their current home less than 10 years, although some have lived there for more than 25 years. Similarly, on the average, families in all sites have lived in their respective areas for about 15 years. The number of long-term area residents (more than 25 years) is considerably lower in Pullman than the other two sites, but other aspects of the distributions are quite similar. Table 3.4 contains those data.

TABLE 3.4. Years in Current Home and in Same Area, by Site

Years	Pullman		Yakima		Longview-Kelso	
	Home	Area	Home	Area	Home	Area
Under 1	3 (06)	1 (02)	4 (08)	3 (06)	5 (10)	1 (02)
1-5	11 (22)	9 (18)	19 (37)	8 (15)	17 (34)	7 (14)
6-10	14 (28)	8 (16)	7 (14)	8 (15)	14 (28)	8 (16)
11-15	15 (30)	12 (24)	12 (23)	3 (06)	10 (20)	12 (24)
16-20	4 (08)	10 (20)	4 (08)	5 (10)	2 (04)	4 (08)
21-25	1 (02)	7 (14)	4 (08)	4 (08)	1 (02)	2 (04)
Over 25	2 (04)	3 (06)	2 (04)	21 (40)	1 (02)	16 (32)
	50	50	52	52	50	50

Percent of responses shown in parentheses

Regarding home ownership, all three sites are unusual in terms of the overall U. S. picture. Percent homeowners by site are 94, 94, and 88 percent respectively for Pullman, Yakima, and Longview-Kelso. Although these figures are unusually high, they are very similar across sites. The high percentage of home ownership will undoubtedly account in part for the reluctance of these families to leave during the Mt. St. Helens eruptions, and may in fact result from samples being selected after the mountain erupted. That is, if renters were more likely to leave than owners, a higher proportion of owners would remain to be sampled. However, it is more likely that the figures reflect the character of the sites studied: they do not contain densely populated urbanized areas. Also, because families with teenagers were selected, it is more likely that they would be homeowners. They are old enough to have worked up to owning a home before inflation and high interest rates made home ownership more difficult.

There is some difference between Pullman and the other two sites in the extent to which respondents feel they can talk with or ask for help from their neighbors. Forty-six percent of the Pullman respondents indicate they can talk with at least 10 neighbors, and 42 percent indicate they can ask for help from at least 10 neighbors. The comparable figures from Yakima are 27.5 and 25.4 percent, and from Longview-Kelso the figures are 26 percent and 25.1 percent. The higher neighborhood linkage represented by the Pullman data may relfect two differences between Pullman and the other sites. First, Pullman is largely a university community and is the smallest of the three sites. In addition, there is more status homogeneity in Pullman. Consequently, it is more nearly a single population with a common link.

In summary, the evidence regarding community linkage indicates essentially comparable length of time in the current residence and in the

current area, comparable levels of home ownership, and considerable neighborhood linkage in terms of talking with or being able to ask for help from one's neighbors. Pullman differs from the other communities in part by having fewer really long-term area residents, and in part by greater neighborhood linkage.

EXPERIENCE WITH MT. ST. HELENS

We next turn to a series of questions dealing with what the households experienced when Mt. St. Helens erupted. Four major eruptions will be considered: May 18, May 25, June 12, and July 22. First, it is important to know whether the families studied were in fact in their respective communities at the times of the eruptions. Across the three sites and the four eruptions, the percent of families in their areas at the time of eruption ranges from 78 to 98. For the May 18 eruption, which was by far the most threatening of the four eruptions, the percentage of respondent families at home was 86 percent for Pullman, 81 percent for Yakima and 88 percent for Longview-Kelso. Consequently, there is very little difference across sites in the proportion of our respondent families that experienced that eruption. Subsequent proportions are higher for all sites with the exception of Pullman on June 12, when only 78 percent were in the area.

Each respondent was asked the following questions: "Has your family, or anyone you know, suffered any of the following losses or had the following problems due to Mt. St. Helens?" Two categories of losses were provided. The first category contained economic losses: loss of job, lost business or work, heavy clean-up expenses, and property damage. There were also the following categories of personal losses or problems: having been in severe danger, experienced injury or sickness, or experienced death. Table 3.5

contains the percentages of the three site samples reporting those different experiences. A number of observations are warranted.

First, there is some difference in typical family experience across the three sites. For example, the Pullman sample shows less than one quarter of the families either experiencing personally or knowing people who experienced any of the [illegible] indicated. On the other hand, over half the Longview-Kelso sample knew others who had property damage or were in severe danger. There is a clear gradient from Pullman to Yakima to Longview-Kelso in the percent of households that knew other people who were affected by the volcano. That is, distance from the volcano directly affects the extent to which people were acquainted with others having the specified problems. That is not true, however, for the families' own experiences. Surprisingly, Yakima shows higher percentages of families experiencing business loss, clean-up expense, property [illegible] and injury or sickness than does Longview-Kelso. In all instances, the Longview-Kelso families have higher percentages of event experience than do the Pullman families.

TABLE 3.5. Experiences by "Your Family" or "Anyone You Know," by Site

	Pullman		Yakima		Longview-Kelso	
Experience	Family	Others	Family	Others	Family	Others
Job Loss	2.0	2.0	8.0	8.0	16.0	28.0
Business Loss	22.0	24.0	46.2	26.9	24.0	36.0
Clean-up Expense	10.0	10.0	38.5	40.4	32.0	46.0
Property Damage	12.0	8.0	34.6	32.7	12.0	52.0
Severe Danger	14.0	12.0	13.5	11.5	16.0	52.0
Injury/Sickness	[illegible]	14.0	15.4	11.5	14.0	20.0
Death	0	0	1.9	0	2.0	24.0

Entries are percents of total samples.

Given the nature of the eruptions, it is not so surprising after all that Yakima had greater proportions of families with the difficulties cited. That is, ash fallout in Yakima was far greater than in Longview-Kelso, and the anticipated Longview-Kelso floods did not develop to the extent that was predicted. Consequently, many more families east of the mountain were faced with massive ash removal, danger to personal health, and considerable damage or business loss due to the disruption caused by the volcanic ash. The surprising fact, perhaps, is that despite their own problems, people in the Yakima families were less likely to know others sharing those problems than were people in the Longview-Kelso area. Thus, although the community involvement and neighborhood acquaintance data showed no important differences between those two sites, it would appear that families in the Yakima area are less aware of the experiences of those around them, suggesting a less strongly connected community network than occurs in Longview-Kelso.

It will become apparent in subsequent portions of this report that a variety of our data suggest a more individualistic attitude in Yakima than in either of the other two sites. It is generally true that communities in eastern Washington (east of the Cascade Range) are more socially and politically conservative than are people west of the mountains. Also, Yakima is the largest site and serves as an urban center to a larger area than do either of the other sites. Consequently it has less "small town" character than Pullman or Longview-Kelso. The politically conservative pattern of eastern Washington does not appear in Pullman because of the influence of the university. Longview-Kelso is west of the mountains. Both sites have a more "bounded" or self-contained character than does Yakima. In any event, the experience data provide the first hint of a more self-reliant, less interdependent approach taken by people in the Yakima area compared to the other two areas.

One other question indicates quite different consequences for the three sites. Respondents were asked whether they knew of families who moved due to the eruption. Answer categories were "no one," "one or two families," "up to ten families," and "more than ten families." Combining the three categories indicating knowledge of at least one family that moved, we find that six percent of Pullman respondents knew of families who moved, compared with 13.4 percent in Yakima and a remarkable 50.0 percent in Longview-Kelso. ALthough the differential awareness of others' experiences suggested by the data in Table 3.5 might account for some of the difference between Yakima and Longview-Kelso, it is apparent that far more families moved from the Longview-Kelso area than from either of the other two areas.

Data from the six-month follow-up interviews augment the difference already indicated. Respondents were asked if they were aware of families who had moved since the last interview. Percentages were: Pullman, 4.2 percent; Yakima, 8.5 percent; and Longview-Kelso, 23.3 percent. It is apparent from these data that only in the Longview-Kelso area were families often and over a long period of time aware of other families moving because of the threat of the volcano. The picture is made more complete by the fact that, whereas none of the Pullman families were aware of more than one or two other families moving, and only two percent of the Yakima families were aware of more than one or two other families moving, 20 percent of the Longview families knew of more than one or two families who left because of the volcano. In fact, six percent of the Longview families knew of more than 10 other families who had left.

Three questions concerned current problems which were attributable to the eruptions of the mountain. Those problems were economic, health, and getting along with each other in the family. Table 3.6 contains the percentage of families in each of the sites indicating that they had such problems.

The distance from the volcano is apparent in the pattern of entries in Table 3.6. With the single exception of health problems 12 months after the eruption, all Longview-Kelso percentages are higher than those from Yakima. For economic and health problems, in turn, Yakima percentages are higher than those in Pullman. There is a very slightly higher percentage of "getting along" problems in Pullman than in Yakima, but the difference is trivial.

TABLE 3.6. Current Problems Due to Mt. St. Helens, by Site and Time

Problem	Pullman		Yakima		Longview-Kelso	
	6 mos	12 mos	6 mos	12 mos	6 mos	12 mos
Economic	0	2.0	5.8	6.4	16.0	16.3
Health	4.0	12.5	9.6	19.1	16.0	11.6
Getting Along	2.0	6.3	1.9	2.1	8.0	14.0

Entries are percents of total samples

In general, the Longview-Kelso families are experiencing greater difficulty on all dimensions than are families in the other areas. Also, the problems do not seem to be getting less frequent with time. In fact, there is a higher proportion of Longview-Kelso families having difficulty getting along at the 12 month re-interview than at the first interview. Similarly, there is twice the proportion of Yakima families experiencing health problems related to the volcano at the 12 month re-interview than at the six month first interview. Although these percentages do not seem high, they do warrant some reflection. Twelve months after the major eruption, nearly one in

five families in Yakima say they have health problems related to the volcano. One in six Longview-Kelso families has economic problems a year after the volcanic eruption, one in nine of those families has health problems a year later, and one in seven families has interpersonal difficulties attributable to the volcano. In short, there is fairly widespread, continuing difficulty traceable to the eruptions of the mountain.

RISK

Two simple questions were included in both the first interview and the follow-up interview to determine the extent to which respondents felt at risk from continued volcanic activity at Mt. St. Helens. Those questions were, "What do you think that the chances are that the mountain will continue to erupt?" and "What are the chances that, if it continues to erupt, it will be a serious threat to your health or property?" Answers to these questions were elicited in percentages, such as 10 percent, and recorded to the nearest 10 percent. It is obvious that the questions are parallel to the components of an expected utility. That is, what is the chance of an outcome and what is the utility of that outcome. In this instance, of course, we are asking about the chance of a negative utility occurring. The product of the two probability statements should indicate the subjective probability that the mountain threatens the family being interviewed.

As a first, simple way of looking at the data, the percentage of families indicating at least a 50/50 chance on each item was tabulated. For the mountain continuing to erupt, those proportions are: Pullman, 80.0 percent; Yakima, 58.6 percent, and Longview-Kelso, 85.9 percent. It is surprising that the Yakima families are noticeably less likely than the other two to believe that the mountain will continue to erupt, whereas Pullman and Longview-Kelso show very similar results. Percentages of families stating that an eruption would be a serious threat to health or property were as

follows: Pullman, 10.2 percent; Yakima, 21.1 percent; Longview-Kelso, 38.4 percent. It is apparent that families in the Longview-Kelso area feel much more threatened by possible continued eruption of the volcano than do families elsewhere. Summarizing the 50/50 percentages from the two questions suggests that Pullman residents say eruptions are likely but not threatening, Yakima residents say eruptions are less likely but more threatening, and Longview residents say eruptions are both likely and fairly threatening.

It is interesting to compare these data with risk perception data from site studies conducted for the Natural Hazards Warning Systems project (Leik et al., 1981). "Overall, 42 percent of respondents living in [hurricane] sites felt that an average strength hurricane would have little or no effect on their property" (Kendall and Clark, 1981, p. 198). Again, the same authors state, "51 percent of the respondents across six [flash flood] sites felt that they would be in no danger."

By contrast, between 62 percent and 90 percent of respondents in the three Mt. St. Helens sites felt that there was less than a 50/50 chance of threat. The most threatened site, Longview-Kelso, is somewhat close to the weather hazard sites, but Yakima and Pullman show far less concern. The questions were worded differently, which may account for the differences. If "little effect" and "moderate effect" from the hurricane threat responses are combined, to be more comparable to a 50/50 chance from the Mt. St. Helens data, then percentages range from 55.5 percent to 78.7 percent across the six sites. Similarly, combining "no danger" and "some danger" from the flash flood threat responses generates percentages ranging from 78.9 percent to 94.0 percent.

It appears, then, that risk perception regarding Mt. St. Helens is not that different from risk perception regarding other natural hazards. This

finding raises the question of whether large portions of a population ever perceive themselves at risk of serious consequences of natural events. Perhaps it is necessary for most people to negate or discount such risk in order to be able to continue life in an area subject to threat.

Would adequate volcano eruption warnings alter these perceptions? The likelihood is that they would not. First, eruption prediction became increasingly accurate over the time of the Mt. St. Helens study. Our re-interview data show only moderate changes in risk perception. Secondly, referring again to the Natural Hazards Warning Systems data, "it appears that standard warning messages act to confirm people's prior perceptions of risk but do not change their perceptions of risk" (Kendall and Clark, 1981, p. 203).

Risk data are presented in a different way in Table 3.7 Here, the mean probability for each item is calculated by site for the first interview (six months after the eruption) and for the re-interview (twelve months after the eruption). Then these two mean probabilities are multiplied to get a mean subjective risk estimate for each time and site. The mean probabilities for continued eruption show surprising consistency across sites and times, with the exception of the low six month mean for Yakima. In general, there is a modest increase from six months to twelve months, suggesting that people living under the threat of the volcano are increasingly convinced that it will continue erupting.

TABLE 3.7. Mean Probabilities of Eruption and Threat, by Site and Time

	Pullman		Yakima		Longview-Kelso	
	6 mos	12 mos	6 mos	12 mos	6 mos	12 mos
1. Erupt	.69	.75	.47	.72	.70	.83
2. Threat if Erupt	.14	.20	.22	.29	.39	.28
3. Risk = (1) X (2)	.09	.15	.10	.21	.27	.23

The second item, whether continued eruptions will threaten health or property, shows much lower mean probabilities which evidence the same distance trend that was apparent in the 50/50 treatment. Interestingly, although Pullman and Yakima means increase from six months to twelve months, the Longview-Kelso mean decreases across that time. It is not evident whether Longview-Kelso families have concluded that their early perceptions of threat were exaggerated, or whether they have accommodated to the threat and no longer perceive it in the same way that they once did.

The subjective risk factor, in the third row of the table, shows a much higher six month value for Longview-Kelso than for either of the other two sites. In fact, it is about three times the risk level of the other sites. The subsequent reduction in perceived threat results in reduction in the calculated risk at 12 months for the Longview-Kelso area, such that it is more comparable to Yakima at re-interview than either is to Pullman. Based on the calculated risk factor, families in Pullman during the first interview saw approximately a one-in-eleven chance that they would experience serious threat to health or property in the future due to the mountain. That same level of perceived threat was in excess of a one-in-four chance for the Longview-Kelso residents. Most people would not take that level of risk with health or property if they felt they had viable options for avoiding the risk.

The perceived risk could be mitigated if people felt that they could somehow protect themselves from or control the results of future eruptions. Two items tap those areas. "It is almost impossible for people to protect themselves from the effects of the volcano (e.g., ash)," and "I was pretty much able to control things happening to me as a result of the volcano (e.g., ash)." Response categories were agree strongly, agree somewhat, disagree somewhat, and disagree strongly. The percentage of respondents who agree

somewhat or agree strongly with the statement that they cannot protect themselves from ash was as follows: Pullman, 42.0 percent; Yakima, 48.1 percent; and Longview-Kelso, 40.8 percent. Clearly, there is a majority in each site who feel that they can protect themselves from the effects of the volcano. Again combining "agree strongly" and "agree somewhat" for responses to the question about being able to control things provides: Pullman, 78.7 percent, Yakima, 84.6 percent; and Longview-Kelso, 84 percent. Again, most respondents felt that the effects of the mountain could be controlled, suggesting that the subjective risk factor would be mitigated by a feeling of being able to handle problems that would arise.

DECISIONS

Three types of data were gathered concerning the families' decisions about avoiding the effects of the volcano. First, a series of questions was asked concerning each of the major eruptions, beginning with prior to the May 18 eruption. Those questions were whether the family evacuated temporarily, whether the family discussed evacuating, and whether the family discussed moving permanently. The second type of data is a single estimate of the probability that the family will move for good, and the last question is "What would be the 'final straw' that would get your family to move permanently?" Table 3.8 contains the percentages of families at each site and each time who evacuated, discussed evacuating or discussed moving.

It is apparent that very few Pullman families did any of these things. The largest percentage was immediately following the May 18 eruption, when 12 percent of Pullman families indicated they discussed evacuating. Figures for Yakima are somewhat larger, reaching 21.6 percent who discussed moving permanently following the May 18 eruption. However, all of the Yakima figures

are quite small. In contrast, Longview families show a considerable amount of concern over the volcano. First, 32 percent did evacuate after the May 18 eruption and 8 percent after the May 25 eruption. In fact, two percent (one family) evacuated before the eruption on May 18 in response to the evidence that the mountain was coming to life.

TABLE 3.8. Actions Taken, by Site and Time

Time	Percent Evacuated			Percent Discussed Evacuating			Percent Discussed Permanent Move		
	P	Y	L	P	Y	L	P	Y	L
Before May 18	0	0	2.0	2.0	2.0	10.0	0	3.9	8.0
After May 18	2.0	3.9	32.0	12.0	11.8	50.0	10.0	21.6	18.0
After May 25	0	0	8.0	2.0	7.8	30.0	2.0	15.7	14.0
After June 12	0	0	0	0	3.9	16.0	0	9.8	4.0
After July 22	2.0	0	0	2.0	3.9	16.0	2.0	7.8	8.0

The evacuation data are interestingly parallel to data from the weather hazard site studies. Percentages who evacuated from hurricane sites varied between 1.7 percent and 37.7 percent. For flash flood sites, comparable figures were from 0 percent to 47.7 percent. Percentages who took shelter in tornado sites ranged between 17.2 percent and 48.0 percent.

The Mt. St. Helens data show that between 2.0 percent and 32.0 percent evacuated at the time of the May 18 eruption. These figures are strikingly similar to the hurricane data. It is easier, of course, to go to a basement shelter (tornado sites) or to high ground (flood sites) than it is to make a major exodus. Hurricanes and volcanoes have in common the fact that they affect broad areas and require considerable travel if one decides to evacuate, in contrast to more geographically restricted threats from tornadoes or flash floods.

After the May 18 and again after the May 25 eruptions, large proportions of the Longview families discussed evacuating, and some continued such discussions for the two subsequent eruptions. Some of the Longview families discussed permanently moving after the May 18 and May 25 eruptions. Those percentages are quite similar to, although slightly smaller than, the comparable percentages from Yakima. As with other data, it is apparent that the May 18 eruption caused widespread concern in Longview and considerable level of concern in Yakima, with relatively little concern in Pullman.

The chance that the family will move for good shows interesting parallels to both the discussed moving data and the subjective risk data. For the first interview (six months) the following mean probabilities of moving for good occurred: Pullman, .06; Yakima, .13; Longview, .14. Comparable mean probabilities from the follow-up interview (12 months) are: Pullman, .10; Yakima, .15; and Longview, .14. Comparing these mean probabilities with the subjective risk data from Table 3.7 shows that all but one of the mean probabilities of moving lie within two thirds to one half of the calculated subjective risk estimates.

That is, both across sites and across time, the probability of moving for good closely parallels the calculated subjective risk. Also, the mean probabilities of moving are generally in the same range as the percentages of families who discussed moving permanently, as shown in Table 3.8. Therefore, the subjective risk evidence, the probability of moving for good, and the extent to which moving was discussed provide reasonably consistent indication of the extent to which the mountain was seen as posing a continual and problematic threat for the families.

The final evidence regarding family decisions from the household surveys is provided by the "last straw" data. Table 3.9 contains that information. The table shows the responses of respondents at each site and time of

interview who gave various "last straw" answers. Many of those answers could be combined into a category emphasizing a natural hazard itself, such as an eruption or the related ash, flood, or earthquake. A second category pertained to the destruction of the respondents' home or town or to everyone in that town leaving. The third category pertained to loss of job or serious economic problems, the fourth to continuing health problems, and the fifth consisted of those who said they simply would not move under any circumstances.

Again, there are some interesting differences by site, particularly comparing Longview-Kelso with the other two sites. During the first interview, 53 percent of Pullman residents and 60.4 percent of Yakima residents provided the first type of "last straw" answer. In contrast, only 31.8 percent of Longview-Kelso respondents gave that type of answer. The second type of answer, destruction of home or town or everyone leaving, was very infrequent in Pullman and Yakima, but constituted 44.7 percent of the first interview responses in Longview-Kelso. It would seem, therefore, that many of the Longview-Kelso respondents envisioned a much more devastating consequence of the mountain than did people in the other two sites.

Note that the "destruction" response disappears by the second interview: only 13.1 percent so respond after 12 months, a percentage very similar to that shown in Yakima. Offsetting that decrease in Category 2 for Longview-Kelso is a sizeable increase in the proportion of respondents indicating a job or economy-based "last straw." Apparently, the disaster scenario implied in the first interview Longview-Kelso answers has given way to an economic s[illegible] re-interview. In most other respects, responses are comparable across sites. Dominant responses are the major natural hazard event itself or economic or job threat. There is a slight increase in the percentage of respondents in Pullman who say they would not move for any

reason, but a very large increase in that percentage for Yakima. The Longview-Kelso percentage decreases and is very small for both interviews. The Yakima shift seems compatible with the emphasis on a kind of determined self reliance which was suggested earlier and will reappear in various other data yet to be analyzed.

TABLE 3.9. Categories of "Last Straw," by Site and Time

Last Straw	Pullman		Yakima		Longview-Kelso	
	6 mos	12 mos	6 mos	12 mos	6 mos	12 mos
1. Eruption, Ash, Flood, Earthquake	53.0	45.8	60.4	39.5	31.8	43.5
2. Home or Town Destroyed, Everybody left	2.0	2.1	14.6	7.9	44.7	13.1
3. Job/Economy	21.6	27.1	16.6	15.8	8.5	30.4
4. Health	11.7	10.4	4.2	10.5	6.4	8.7
5. Wouldn't Move	11.7	14.6	4.2	26.3	8.5	4.3

Entries are percentages of total responses per site and time

STRESS

Two approaches were used for assessing the extent to which families were under stress. Only one of those was used with the telephone survey households: a reduced form of an inventory of stressful life events. Twenty-four specific events were listed, and each respondent was asked to indicate whether or not that event had occurred for the family being interviewed. During the first interview, two answers were elicited for each event: whether it occurred before the May 18 eruption, and whether it occurred after that eruption. In the [illegible] interview, a single answer was elicited per item:

whether it had occurred since the first interview. Since many of the events are potentially recurrent, such as loss of job or change of school status of one of the children, it is possible that a given item could have occurred on all three occasions.

Before examining the data from these stress items, it should be noted that they are presumably objective events rather than subjective feelings of stress. The life stress scale approach has assumed that the kinds of items listed are likely to be stressors even though they may also be desirable events, such as promotion. Setting aside the debate about whether items should be considered stressors if they are also desirable, we are interested in whether there is any indication that sizeable stress levels existed apart from that produced by the mountain, and whether those stress levels in any way varied by site or by time. Because the events are presumably objective, stress scores should vary by site or by time only if there is some logical reason why the volcano or the different areas of Washington State would result in different probability of the events occurring.

Table 3.10 provides mean life event stress scores by site and by time. For each respondent household, a stress score was computed simply by adding the number of events which occurred for the time interval under analysis. Thus, a stress score was computed for prior to May 18, one for after May 18, and one for after the first interview. Mean scores were then calculated across the cases for each site. It is evident from Table 3.10 that mean stress scores are all quite low (up to 2.4 items out of a battery of 24 items). It is also important that mean scores vary consistently with distance from the volcano and over time. That is, the closest site and the time immediately following the major eruption provide the largest mean stress scores.

TABLE 3.10. Mean Life Event Stress Scores, by Site and Time

Time	Pullman	Yakima	Longview-Kelso
Before May 18	.82	.89	1.26
After May 18	1.52	2.04	2.40
After First Interview	[illegible]	1.37	1.26

Scores were number of stressors experienced, out of 24 listed.

There is some suggestion, then, that either the volcano affected the likelihood of such events occurring, or that recollection of stressor events was influenced by proximity to the volcano. As will be discussed in the next chapter, it is possible to attribute some of the time variability to certain seasonal items, such as children entering or leaving school. Since school ended after the May 18 eruption and before the second interview, those items would tend to elevate the scores after May 18. We will not re-analyze the scores at this time, but re-analysis of the family-based stress scores suggests that these same time variations appear whether or not such seasonal items as leaving or entering school are removed from the scale.

We are faced, then, with the possibility that the mountain has intruded into the lives of the people living near it in ways that were not immediately obvious at the outset. That is, it has in some ways affected the likelihood of occurrence of common, standard stressor events. That influence is seen not only in the changes in the mean scores recorded in Table 3.10, but also in the maximum scores observed at the different periods of measurement. Thus, the highest score observed prior to May 18 was 5, whereas the highest

individual score observed after May 18 was 10. That is an extraordinary number of stressor events piling up within a relatively restricted time span.

Certain items from the life events list were examined to determine whether they had been the source of elevated stress scores after May 18. Illness showed no effect for any of the sites despite a number of families attributing health problems to the volcano. Similarly, emotional problems remained comparable for Yakima and Pullman, but did increase three-fold in Longview-Kelso (6 percent to 18 percent).

Unanticipated expenses show sizeable increases for all three sites. Of course, it was necessary for many households to pay considerable clean-up costs after the May 18 eruption. The percentage of households reporting such unanticipated expenses, for all sites combined, went from 3.9 percent to 14.6 percent.

As a check between the life events items and the experience items reported in Table 3.5, a simple count of the experiences per household was prepared. For convenience, this extent of negative experiences due to the volcano was labeled a "had it" score. Two versions were calculated: one for the family itself and one for knowledge of others' experiences.

Both "had it" scores show strong and statistically significant differences across sites, consistent with the distance gradient from Mt. St. Helens. More importantly, both scores correlate significantly with the stress scores before May 18 and the stress scores after May 18, the correlations varying from .15 to .31. Although these are not large correlations, they suggest that there is some common content in the two types of question.

The correlations with post-May 18 stress scores are not problematic. In fact, they indicate content validity to some degree. However, the correlations with pre-May 18 stress scores appear to pose a problem of spurious relationships. [illegible] experiences after the eruption correlate with

life events prior to the eruption? The simplest answer is that the pre- and post-stress scores are themselves correlated. That correlation is .23 ($p < .01$).

If it is reasonable for life event stress scores at two time points to be correlated, then the data are readily interpreted: stress prior to May 18 is related to stress after May 18 which is in turn reflected by, hence correlated with, experiences with Mt. St. Helens. Certain life event items, such as interpersonal problems, emotional problems, illness or disability, might well be recurring. Although these items do not constitute the major portion of the life events list, they could provide sufficient over-time commonality that the pre- and post-stress scores would be correlated. It appears likely, then, that the eruptions of the mountain have indeed affected the number of stressors checked on the inventory of life events, but that the affected items are different from the ones which cause the autocorrelation in the stress scores. A more detailed examination of such effects would be most useful in future research.

COPING

In addition to the life events stress scale items, respondents were asked about a series of ways they might cope with elevated stress. Some of those coping mechanisms were primarily oriented to involvement with other people (talking about one's feelings, relating to others, talking with one's family, and attending gatherings), some were "vices" (smoking, taking prescription medicine, drinking alcohol, gambling), some were escape mechanisms (reading, hobbies, eating, dieting, sleeping, watching television, daydreaming, and traveling), and some emphasized emotional feelings or displays (being angry, crying, being thankful, keeping problems to oneself, showing strength,

and never showing fear). Three items pertained to direct attempts to solve problems (seeking counseling, planning for the future, and seeking information about other jobs) and two pertained to religion (believing in God and attending religious activities). For each item, the respondent was asked to indicate whether he or she was doing more of that since the eruption, less of it, or about the same amount of it as before the eruption. If the items were not appropriate (e.g., the respondent did not smoke at all), then a "not applicable" response was recorded.

To simplify analysis of these items, three computations were made per item. First, the number of respondents indicating change (either more or less) was recorded, secondly, the balance of change (more minus less) was calculated, and finally, the percent shift was computed as that balance divided by the total number of respondents. Because there are so many items, they will be analyzed for the total three-site sample rather than by site. Both first interview and second interview data will be presented, with the second interview emphasizing change since the first interview. Table 3.11 contains those data.

The most immediately evident aspect of Table 3.11 is that virtually all changes are in the direction of more rather than less of the particular coping mechanism. If such behaviors were randomly distributed over time, with increasing or decreasing each behavior being equally likely at any given time, then it would be very unlikely that virtually all items would show increased activity. However, it is reasonable to expect that if stress levels and objective problems are greater after the May 18 eruption, then a greater variety of coping behavior will be necessary to maintain reasonably stable existence. The dominant forms of coping appear to be sociable behaviors, especially talking about feelings and with family, relating to others, reading,

TABLE 3.11. Changes in Coping Behavior, by Time

Behavior	First Interview			Second Interview		
	# Changing (more + less)	Balance (more - less)	% Shift (Bal/152)	# Changing (more + less)	Balance (more - less)	% Shift (Bal/138)
"Social"						
Talking about feelings	43	+31	+20.2*	27	+ 7	+ 5.1
Talking with family	36	+30	+19.7*	37	+27	+18.1*
Relating to others	29	+27	+17.7*	29	+25	+19.6*
Attending gatherings	28	+ 6	+ 3.9	34	+28	+20.2*
"Vice"						
Smoking	14	+10	+ 6.6*	13	+ 3	+ 2.2
Prescription drugs	10	+ 8	+ 5.3*	14	+12	+ 8.7*
Alcohol	7	+ 1	+ .7	5	+ 3	+ 2.2
Gambling	4	+ 2	+ 1.3	8	- 6	- 4.3
"Escape"						
Reading	35	+33	+21.7*	23	+23	+16.7*
Hobbies	38	+18	+11.9*	19	+19	+13.8*
Eating	19	+ 3	+ 2.0	1	- 1	- .7
Dieting	27	+19	+12.5*	14	+14	+10.1*
Sleeping	24	- 4	- 2.6	6	+ 6	+ 4.3
Watching TV	29	+ 3	+ 2.0	9	- 9	- 6.5
Daydreaming	11	+ 5	+ 3.3	2	+ 2	+ 1.5
Traveling	53	- 3	- 2.0	11	-11	- 8.0
"Feeling or Showing Emotion"						
Being angry	22	+10	+ 6.6*	17	+ 1	+ .7
Crying	8	+ 4	+ 2.6	9	- 3	- 2.2
Being thankful	66	+62	+40.8*	35	+33	+24.0*
Keeping problems to self	20	- 6	- 3.9	13	- 5	- 3.6*
Showing strength	23	+21	+13.8*	16	+12	+ 8.7*
Never showing fear	23	+ 5	+ 3.3	12	+ 4	+ 2.9
"Solving"						
Seeking counseling	8	+ 4	+ 2.6	8	+ 6	+ 4.3
Planning future	30	+24	+15.8*	29	+23	+16.7*
Finding out about other jobs	25	+15	+ 9.9*	35	+19	+13.8*
"Religion"						
Believing in God	23	+19	+12.5*	14	+12	+ 8.7*
Attending religious activities	13	+ 7	+ 4.6	15	+ 9	+ 6.5*

* Probability <.05 that, if "more" and "less" are equally likely, the balance will be at least as far from zero as that observed.

and especially being thankful. After those items, the most consistent change occurs in planning for the future. Similar patterns are observed from the second interview data, although there is much less increased talking about feelings and a greater increase in attending gatherings.

The columns in Table 3.11 contain quite different kinds of information. The column showing the number of people changing indicates in general the extent to which a given type of activity has been affected by the mountain. For example, nearly half of the people interviewed changed their level of being thankful, with almost all of them increasing their thankfulness. About one third of the respondents changed their amount of traveling, but almost equal numbers increased or decreased their traveling such that the balance was near zero. Thus the second column indicates whether changes have been predominantly in one direction or more equally random around no change. The third column represents the extent to which a shift has occurred in the total sample. That is, the balance changing in a given direction (second column) is divided by the total number of cases interviewed. An asterisk following the third column entry indicates that, if doing more of an item is equally likely as doing less of that item, then there is less than a five percent chance that as large a balance would be observed as is recorded in column two. Those probability computations depend upon the number of changes taking place, rather than on the total sample size. The columns for the second interview data parallel those just described for the first interview data.

The overwhelming evidence from Table 3.11 is that people affected by the mountain are sharing their feelings, engaging in social activities, being thankful, planning for the future, and believing in God much more than

they did before the May 18 eruption. Most of those increases continue through the second six month period. Very little negative behavior is evident in the responses.

To assess the relationship between coping behaviors and experiencing stressors, a scale was constructed by adding one point for doing more of each of the following items: talking about feelings, talking with family, relating to others, reading, being thankful, showing strength, planning for the future, and believing in God. Those are the dominant items appearing in Table 3.11. To emphasize changes due to the major eruption on May 18, only the first interview items will be used.

To simplify the analysis of coping scores related to sources of stress, cross tabulations were prepared showing whether the event was experienced or not by high verus low coping score. The breaking point for the dichotomization of coping was established to maintain as nearly balanced halves of the table as possible. A necessary caution must be indicated, however. Relatively few families experienced any of the events listed, so that the tables are highly skewed with reference to experience. Consequently, any index of association is subject to instability because of marginal skew.

Table 3.12 shows values of Yule's Q for the relationship between coping score and whether the family experienced the particular event, as well as the relationship between the coping score and whether they knew of others who had such an experience. For experiencing job loss, the family-coping relationship is higher than the other-coping relationship. For all other events, however, the coping score is more strongly associated with knowing of others who experienced problems than it is with having those problems in the family. This apparently strange result makes sense if one remembers that the coping scale includes items such as being thankful, showing strength,

planning for the future and believing in God. Those items in particular are easier responses to knowing about others' problems than they are to one's own problems. That is especially obvious regarding feeling thankful. It is much more difficult to be thankful when one has experienced difficulties than when one knows of others who have but has managed to escape them oneself.

The pronounced differences in the associations shown in Table 3.12 suggest that the positive reaction evident in the coping items is primarily a consequence of having escaped a bad situation while others have had severe problems as a result of that situation. High coping scores, then, are not apparently indicative of being able to manage severe problems caused by Mt. St. Helens, but rather are indicative of being able to respond favorably to having escaped those problems.

TABLE 3.12. Relationships Between Coping Score and Specific Experiences

Event	Family Experienced	Know Others Who Experienced
Job Loss	.54	.29
Property Damage	.05	.56
Clean-up Expense	.37	.46
Severe Danger	.13	.58
Injury or Illness	.12	.37
Death	.11	.75

Values of Yule's Q, with Coping dichotomized into high versus low.

Three final items deserve brief comment in this discussion of the household interviews. When respondents were contacted for follow-up interviews, each was asked at the end of the interview whether the first interview had influenced the extent to which the respondent had talked to the family about

Mt. St. Helens, the extent to which the respondent had talked to others about Mt. St. Helens, and the extent to which the respondent had different feelings about the mountain since the first interview.

Regarding talking to the family, the following percentages indicated an increase due to the first interview: Pullman 33.3 percent; Yakima, 42.6 percent; Longview-Kelso, 79.1 percent. It is apparent that the first interviews considerably affected all three sites, with the effect being far greater in Longview-Kelso than in either of the other two sites. In fact, the difference between sites is statistically significant beyond the .000 level. The first interviews also influenced the extent to which respondents talked to others about the mountain. Percentages are: Pullman, 35.5 percent; Yakima, 44.7 percent; and Longview-Kelso, 62.8 percent. This pattern is very similar to that for talking to the family, although not quite as extreme a difference between the sites. Again the results are statistically significantly different across sites.

Finally, the percent who said that they had different feelings about the volcano after the first interview were: Pullman, 18.8 percent; Yakima, 21.3 percent; and Longview-Kelso, 23.3 percent. Apparently the interviews induced greatly increased levels of conversation within families and to others, but did not cause extensive changes of feelings toward the mountain. Because it is known from other research that talking about threat of a hazard can influence one's willingness to take protective action, it is interesting to speculate whether conducting interviews with populations at risk could induce greater awareness and willingness to respond to those threats.

SUMMARY

A great deal of information has been presented in this overview of the household telephone survey. Although a sizeable difference in occupational status exists between Pullman and the other sites, in more respects the sites are quite comparable in the types of families studied. Results indicate that distance from the mountain clearly affected both the extent to which difficulties were experienced and the extent to which action was taken or at least discussed by the families. In addition, the levels of stress experienced and the type of coping demonstrated consistently vary across sites. Finally, it is apparent that some indicators of stress have decreased over time since the May 18 eruption, but others have increased, suggesting that Mt. St. Helens continues to play a major part in the lives of the people living in its shadow.

Chapter Four

THE FAMILY INTERVIEWS

As was indicated in Chapter Two, two types of data were gathered about family decisions concerning Mt. St. Helens. First, a survey of 50 households in each community was conducted by telephone. Those data were reported in the previous chapter. Second, in-depth interviews were conducted with 20 families in each of the Washington State communities, plus 10 families in Minneapolis, Minnesota. The purpose of the in-depth family interviews was to enable interviewing more members of the same household so that the interpersonal dynamics aspect of family decision making could be examined, as well as greater detail about the individuals' responses to the mountain. However, 20 cases per community constitutes a very small sample. Therefore, it will be desirable initially to examine the demographic characteristics of these families to determine the extent to which they represent the same population as the larger telephone survey represented. Of course, minor fluctuations would be expected with small samples, but we need to ascertain that these families are not particularly unusual in their perceptions of the problems created by Mt. St. Helens, and in the manner in which they reacted to those problems.

DEMOGRAPHICS

Table 4.1 shows the ages of the husbands and wives in the interview families. It will be recalled that only one household member was interviewed in the telephone survey, but ages of both parents were obtained. Both the family interview age distributions and the telephone survey age distributions

are shown in the table. It will be convenient for the rest of the report to use the label "Interview" to refer to the family in-depth interviews, and the word "Survey" to refer to the telephone survey of households.

TABLE 4.1. Age of Parents: Interview Families versus Survey Households

Age	Husbands		Wives	
	Interview	Survey	Interview	Survey
20-29	0 (0)	0 (0)	0 (0)	2 (01)
30-39	14 (20)	47 (31)	21 (30)	67 (44)
40-49	37 (53)	64 (42)	38 (55)	50 (33)
50-59	13 (19)	33 (22)	6 (09)	30 (20)
60-69	4 (06)	7 (05)	4 (06)	2 (01)
70 or over	2 (03)	1 (01)	0 (0)	0 (0)
	70	152	69	151
No response	0	0	1	1

Chi square (husbands) = 6.5 n.s. (60 + combined)
Chi square (wives) = 10.0 $p<.05$ (20-39 combined, 60 + combined)

It is evident from Table 4.1 that there are minor differences in the age distributions of both the husbands and the wives. In particular, there are slightly fewer age 30-39 parents and slightly more age 40-49 parents of both sexes in the Interview samples. A chi square test for the husbands indicates that there is no significant difference between the two samples. However, the same test for the wives shows a significant difference. The overall effect of that difference is to "pile up" the Interview wives in the age 40-49 bracket, with comparably fewer wives in the age bracket on either side. Thus, there is little difference in the mean ages, but rather a more dense concentration of ages in that one category. That concentration could make moderate shifts in the age distribution of children in the household and in such factors as whether or not the wives work outside the home. We will examine those factors next.

Table 4.2 contains the work status of the parents from both the Interview sample and the Survey sample. Both husbands and wives are employed in very similar proportions in both samples. The chi square tests are clearly nonsignificant, although there are minor percentage differences between the distributions for the wives. As suggested by the age difference, a slightly larger proportion of the Interview wives work full time or part time, with comparable reduction in the proportion that are unemployed. However, these are very small differences.

TABLE 4.2. Work Status of Parents: Interview Families versus Survey Households

Work Status	Husbands		Wives	
	Interview	Survey	Interview	Survey
Full time	63 (94)	136 (95)	34 (53)	68 (46)
Part time	2 (03)	3 (02)	11 (17)	17 (11)
Unemployed	2 (03)	5 (03)	19 (30)	64 (43)
	67	144	64	149
No response	3	8	6	3

Chi square (Husbands) = .01 n.s. (part time and unemp. combined)
Chi square (Wives) = 3.9 n.s.

Turning to the question of occupational distribution, we are again reassured that the Interview and Survey samples are very similar. Table 4.3 contains the occupational distribution for both samples for husbands and wives. There are minor differences throughout the tables, as would be expected, but all chi square tests for distribution similarity are nonsignificant. It should be noted, incidentally, that various categories in Tables 4.1 [illegible] have been combined in order to enable the chi

square tests. Combining categories is required by the fact that, for the test to be valid, expected frequencies should be at least five in all cells of the table. With such infrequent categories as, for example, the service occupation category, expected frequencies would be much too small. The footnotes in the tables show the manner in which categories have been combined.

Table [illegible] Occupation of Parents: Interview Families versus Survey Households

Occupation	Husbands		Wives	
	Interview	Survey	Interview	Survey
Prof/Tech	29 (44)	47 (33)	11 (25)	18 (21)
Manag/Admin	13 (20)	20 (14)	6 (14)	8 (09)
Clerical	4 (06)	3 (02)	18 (41)	39 (46)
Craft/Fore	11 (17)	40 (28)	2 (05)	6 (07)
Transp Op	3 (05)	7 (05)	0 (0)	0 (0)
Nonfarm Lab	3 (05)	16 (11)	3 (07)	8 (09)
Service	2 (03)	0 (0)	3 (07)	4 (05)
Farm, Farm Lab	1 (01)	9 (06)	1 (02)	2 (02)
	66	142	44	85
No response	4 (06)	10 (07)	26 (37)	67 (44)

Chi square (Husbands) = 5.0 n.s.
(Clerical and Craft/Fore combined, Trans Op through Farm combined)
Chi square (Wives) = .95 n.s.
(Prof/Tech and Man/Adm combined, Clerical and Craft/Fore combined, and Trans Op through Farm combined)

The remaining piece of evidence about similarity of the survey and interview samples concerns the age distribution of children in the household. There is a very similar percentage of households in the two samples that have children in the 13 to 18 age group (Interview, 97.1 percent; Survey, 97.6 percent). [illegible] proportion of households containing children six or younger is quite comparable (Interview, 11.6 percent; Survey, 10.5 percent). It is the children in the age range 7 to 12 where the largest difference occurs. Thirty-three and three-tenths percent of the Interview families

have children in that age group, whereas 57.8 percent of the Survey households contain children of that age. Undoubtedly, this difference is attributable to the fact that there are relatively fewer wives under 40 in the Interview sample. Also, the fact of fewer young children in the household accounts for the slightly higher proportion of wives who are working outside the home. In general, however, these are small differences which should not strongly affect the overall characteristics of the families' reactions to Mt. St. Helens.

COMMUNITY LINKAGE

There are three types of information pertinent to the extent to which the families studied are linked to their communities. First is the length of time they have lived in their current home and in the general area of their community. Second is the extent of acquaintance they have in their neighborhood. Specifically, we will examine the number of neighbors they feel they can talk with and the number of neighbors they can ask for help, parallel to the data presented for the Survey households. Third is the question of the proportion of families who own their own homes. Because involvement in the community has been shown to have some effect on response to emergencies, differences on these variables could influence the comparability of the two samples for studying response to Mt. St. Helens.

The data on the number of years the family has lived in their present home and the number of years they have lived in the same general area will not be presented in detail because they show no important differences from the distributions presented for the Survey households. The largest percentage difference between the samples across the five-year intervals shown for the Survey families in Table 3.4 is 10 percent in the 11-15 year category. However, that difference is exactly offset in the next five year group, such

that the overall distributions become very similar. There is no percentage discrepancy that large for the length of residence in the general area. Regarding the length of time the family has been either in their current home or in the area, then, there are neither statistically significant nor theoretically important differences.

Some differences appear when we examine the extent to which families feel they can talk with their neighbors and can ask their neighbors for help. Table 4.4 contains relevant data from the Interview families as well as the comparable information from the Survey households. When the Interview families are asked about how many neighbors they can talk with, a much higher proportion indicates a fairly extensive acquaintance with their neighborhoods than did in the Survey. Within samples, there is very little difference between the husbands, wives, and teenagers in the data presented in Table 4.4.

The question asked simply how many neighbors the respondent could talk with or could ask for help. We will present four summary facts: the proportion of the sample that indicated that they could speak with at least 10 of their neighbors, the proportion who could speak with at least 20 of their neighbors, and the proportion that could ask for help from at least 10 and at least 20 neighbors

TABLE 4.4. Talk With and Ask for Help from Neighbors: Interview Families versus Survey Households

	Interviews			Survey
Talk With	Husbands	Wives	Teenagers	
More than 10	58	47	42	34*
More than 20	32	26	22	12*
Ask for Help				
More than 10	37	34	27	31
More than 20	20	15	10	10

Entries are percent of responses indicating at least 10 (at least 20) neighbors.

*Indicates that survey percentage is significantly different from average of interview percentages for husbands and wives, at the .05 level.

Because the Survey proportions represent responses by both male and female parents, it will be convenient to average the husband and wife interview percentages in order to test the similarity of the Interview responses with the Survey responses. For talking with neighbors, the average husband-wife percentages are: more than 10, 52.5 percent; more than 20, 29.0 percent. Both of these percentages are considerably higher than the Survey percentages (34.0 and 12.0, respectively). In fact, these differences are statistically significant at the .05 level. Consequently, we must conclude that the Interview families feel more widely acquainted in their neighborhoods than do the Survey families.

Regarding asking for help, no such differencs appear. The average husband-wife percentage for being able to ask more than 10 neighbors for help is 35.5, compared with 31 percent for the Survey households. For more than 20 neighbors, the average husband-wife percentage is 17.5, compared with 10.0 for the Survey households. Neither of these differences is statistically significant, nor does either imply an important difference in community linkage. To the extent that wide acquaintance in the neighborhood can alter emergency response, we need be somewhat concerned about sample comparability. However, the information about asking for help is reassuring regarding the essential similarity of the extent to which our families are linked in their neighborhoods.

Data on home ownership show almost as high a rate in the Interview families as was observed for the Survey households. Eighty-three percent of the families interviewed own their own home, compared with 92 percent of the Survey households. Although home ownership can influence one's willingness to leave an area, the observed percentage difference is so small as to pose no theoretical problems for comparability of the data. However, both

percentages are considerably higher than the national average, so our results must be interpreted with that bias in mind. It will simply be more difficult for home owners to "pick up and leave" than it would be for renters. As noted earlier, since our samples represent families who have not moved (or we would not have been able to re-interview them later), it is possible that the high home ownership rate reflects the sampling procedures. It is also the case that families in the middle years are more likely to own homes than at any other life stage, making the higher proportions of home ownership more compatible with national data.

EXPERIENCE WITH MT. ST. HELENS

Before examining specific experiences which the family had with Mt. St. Helens, it is important to determine that they were in fact in the ara during the eruptions. Examination of those data indicate percentages very similar to those shown in the household survey. That is, between 87 and 93 percent of the husbands were in the area during each of the eruptions, 83 to 95 percent of the wives were in the area for those eruptions, and 83 to 90 percent of the teenagers were in the area. The survey data show 85 to 92 percent of respondents indicating they were in the area. Therefore, about nine out of ten of the people studied were directly subject to the effects of Mt, St. Helens. Of course, property could be damaged whether or not people were in the area, and other difficulties could last over a long enough period of time that they would still affect the families after they had returned from short trips or temporary evacuation.

Parallel to the data provided on the Survey households, it was determined whether each member felt that the family had experienced each of a set of specific problems. Those problems were: loss of job, loss of business or

work, clean-up expense, property damage, severe danger, injury or sickness, or death. Also, each person was asked whether they were aware of others who had had such experiences. Table 4.5 contains the percentages of husbands, wives and teenagers who indicate that their family had such experiences.

TABLE 4.5. Experiences by Your Family, by Age/Sex

Experience	Husbands	Wives	Teenagers
Job Loss	0 (0)	2 (03)	1 (02)
Business Loss	17 (28)	25 (42)	6 (10)
Clean-up Expense	32 (53)	21 (35)	14 (23)
Property Damage	13 (22)	14 (23)	7 (12)
Severe Danger	14 (23)	10 (17)	8 (13)
Injury/Sickness	6 (10)	6 (10)	8 (13)
Death	1 (02)	1 (02)	1 (02)

Percent shown in parentheses

There are some intriguing discrepancies, across members of the family, which appear in Table 4.5. For example, 42 percent of the wives indicate business or work loss, compared to 28 percent of the husbands and 10 percent of the teenagers. Is it possible that wives lost work due to the mountain, and reported that loss as part of the family's experience, whereas husbands less often noted their wives' loss of work? Such a bias would certainly be compatible with the traditional view that men are the primary earners of the households and that women's work constitutes at best a supplement to the income. Thus, even though about half of the wives are working, there is a suggestion here that the husbands do not consider a reduction in their working to be a family loss. Similarly, 53 percent of the husbands indicate clean-up expense, compared to 35 percent of the wives and 23 percent of the teenagers noting such expense. Again, this discrepancy may be attributable to a

greater responsibility for the men to take care of the consequences of the ash fallout, hence a greater awareness on their part of actual expenses incurred.

Although these comments are quite speculative, they do raise the general methodological question of whether one respondent per household can provide reliable information. The teenagers, for example, report lower rates of all kinds of loss except injury or sickness. One wonders whether accounts of disasters are biased by who was interviewed.

Whether family members knew of others who experienced these types of problems is indicated in Table 4.6. Again, teenagers indicate fewer instances of awareness than do husbands and wives. The parents are in fairly close accord, with the possible exception of awareness of others' business losses or property damage. Husbands are more likely than their wives to be aware of others suffering business losses. That fact may simply relate to their greater likelihood of involvement outside the household, since a much larger proportion of husbands work outside the house. On the other hand, wives report more instances of property damage than do husbands. These are not large percentage differences, and speculation about them may be inappropriate, but such a difference would be consistent with a more active communication network among the wives regarding other families versus a more active communication network among the husbands regarding business and work situations.

TABLE 4.6. Experiences by Anyone You Know, by Age/Sex

Experience	Husbands	Wives	Teenagers
Job Loss	3 (05)	4 (07)	1 (02)
Business Loss	22 (37)	17 (28)	6 (10)
Clean-up Expense	25 (42)	24 (40)	18 (30)
Property Damage	17 (28)	23 (38)	15 (25)
Severe Danger	11 (18)	10 (17)	9 (15)
Injury/Sickness	5 (08)	9 (15)	2 (03)
Death	3 (05)	4 (07)	6 (10)

Percent shown in parentheses

Both Table 4.5 and Table 4.6 appear to agree quite well with data from the Survey. Interview parents indicate clean-up expenses for both their own families and others more often than do the Survey respondents. Those differences are not very large, however, and other experiences show much more similar results.

Turning to current problems due to Mt. St. Helens, we again find a basic similarity between the Survey and the Interview data. Table 4.7 provides the extent to which each of three problems was reported by each of the family members at the first and second interviews. It should be remembered, of course, that there are only 30 families in the second interviews, whereas there were 60 initially interviewed. Therefore, although the frequencies may drop between the six month and the twelve month periods, the percentages may increase because of the change in the denominator. Also, it should be noted that the analyses beginning with Table 4.5 (that is, experience with the mountain) do not include the Minneapolis families. It would be inappropriate to compare those with the survey data, and in fact the Minneapolis households were not asked many of the questions that the Washington State families were asked because they would seem ludicrous given the distance from the volcano.

TABLE 4.7. Current Problems Due to Mt. St. Helens

Problem	Husbands		Wives		Teenagers	
	6 mos	12 mos	6 mos	12 mos	6 mos	12 mos
Economic	3 (05)	0 (0)	11 (18)	2 (07)	1 (02)	0 (0)
Health	[illegible] (10)	5 (17)	7 (12)	5 (17)	2 (03)	0 (0)
Getting Along	2 (03)	0 (0)	5 (08)	1 (03)	4 (07)	3 (10)

[illegible] shown in parentheses, based on 60 families at [illegible] mos., 30 families at 12 mos.

It is clear from Table 4.7 that relatively few families have experienced economic, health or getting-along problems. However, as many as one in six husbands and wives indicate health problems during the second interview. This is quite comparable to the one in seven rate which appeared in the household survey. Minor discrepancies in whether percentages increase or decrease across time in the two samples are not worth detailed commentary. However, teenagers report lower incidences of both economic and health problems than do their parents, but higher incidences of problems in getting along in the family. Of course, teenagers are notorious for problems in getting along with their families, but as much as one year later, one out of ten teenagers attribute such interaction problems to the Mt. St. Helens eruption. Either some of the teenagers have experienced stresses not perceived by their parents, or they have used the volcano as a convenient explanation of problems that have other roots.

It is also interesting to note in Table 4.7 that wives consistently indicate higher levels of difficulty than do husbands. That is, with the single exception of the proportion indicating health problems during the re-interview, all wife percentages are higher than the comparable husband percentages. As with the teenage differences it is difficult to know whether these differences are attributable to differential acquaintance with problems, perhaps due to different sex roles, or whether the differences are attributable to different modes of response to a major stressor like Mt. St. Helens.

RISK

How do the respondents perceive the future of Mt. St. Helens as a threat to themselves and their families? Table 4.8 indicates mean probabilities that the mountain will continue erupting and that it will pose a serious threat to the family's health or property if it does so. Also, the risk computation

which was performed for the survey households is presented in Table 4.8. The estimated probabilities that the mountain will continue to erupt are very consistent across the different family members. Teenagers show slightly lower probabilities than do their parents at the six month level in particular, but the discrepancies are not particularly large. The probability that if the mountain continues to erupt it will threaten the family is in general higher in Table 4.8 than comparable probabilities reported in Table 3.7 for the household survey. As a result, the risk indicated in Table 4.8 is noticeably higher than it was for the Survey households for the six month interview in particular. Because the perceived threat drops from the six month to the twelve month interview for all three family members, the twelve month risk estimate is much more in line with that from the Survey data.

TABLE 4.8. Mean Probabilities of Eruption and Threat

	Husbands		Wives		Teenagers	
	6 mos	12 mos	6 mos	12 mos	6 mos	12 mos
Eruption	.79	.69	.76	.76	.60	.66
Threat if Erupt	.44	.20	.57	.39	.44	.35
Risk	.35	.14	.43	.30	.26	.23

p(Risk) = p(eruption) X p(threat if eruption)

Wives consistently estimate the probability of threat considerably higher than do their husbands, even though there is general agreement regarding the probability of future eruption. Consequently, the wives generate higher risk figures than do their husbands. By the time of the second interview, the estimates of the eruption and threat probabilities

generate a risk factor more than double that of their husbands, and somewhat larger than that of the teenagers in the household. Who is involved in the decisions regarding whether or not to escape the threat of the volcano is particularly important in light of these differences within families. We will turn to that information shortly.

One other way of trying to determine whether the mountain was presenting problems for the families was their agreement or disagreement with statements about being able to protect themselves from ash and being able to control the results of the ash fallout. Data from the families on those two questions are as follows. First, combining the "agree" and "agree strongly" answers to the question about not being able to protect against the ash, we find 38.4 percent of the husbands, 50 percent of the wives and 33.3 percent of the teenagers concur with that statement. Those are quite large percentages, although not particularly different from the Survey percentages. Similarly, 13.4 percent of the husbands, 21.7 percent of the wives, and 10 percent of the teenagers indicate that they cannot control results of the ash. Those figures are again comparable to the Survey data and compatible with results from studies of other hazards. As with the risk data, wives again show the highest level of concern over the mountain.

SEARCH

No evidence was available from the Survey questions regarding whether the families undertook any form of serach for more information before deciding how to respond to the volcano. On the other hand, the family interviews contained five questions pertinent to information search. Questions concerned whether the family had tried to get better information about how the mountain might act in the future, whether the family had tried to get better

information about how to protect the home from any damage the mountain might cause, whether the family discussed what possibilities there might be elsewhere for job, school, and home, whether the family tried to figure out actual dollar costs of different things they might do such as moving, and whether the family tried to figure out the advantages of those options that might be available to them, such as moving. Each question contained five alternative answers: not at all, a little, some, quite a bit, and a great deal.

It is apparent that most families did little, if any, searching. Consequently, the four answer categories other than "not at all" are combined in the following analysis. Table 4.9 presents the proportion of husbands, wives or teenagers who indicated that any of the actions were taken. Note that 70 percent of the wives indicate an attempt to get more information about what the mountain was going to do in the future. Teenagers show nearly as high a frequency, whereas husbands were much less likely to state that such action had been taken. Similarly, wives and teenagers much more frequently indicated attempts to get better information about protection from damage, compared to the husband responses. In fact, four of the five questions show much larger response rates from wives and teenagers than from husbands. The only item in which there is substantial agreement is trying to determine the dollar costs of the various options available.

In general, the family members indicate quite low rates of considering alternatives and their possible costs. Yet it is an essential aspect of rational decision making to weigh options against current behaviors and in some way choose optimally between them. These data suggest, then, that the primary concern of the search behaviors was to be able to continue in the current residence (by knowing better what the mountain was going to do

TABLE 4.9. Search Behaviors

Behavior	Husbands	Wives	Teenagers
Get Better Info About Future Action of Mtn	41.7	70.0	63.3
Get Better Info About Protection for Damage	36.7	58.3	57.6
Figure Dollar Costs of Options	13.8	13.3	17.2
Discuss Advantages of Options	13.3	30.0	28.3
Discuss Possibilities Elsewhere	13.3	25.0	23.3

Percent responding "a little," "some," "quite a bit," or "a great deal."

and how to protect against it) rather than to consider the possibility of getting away from the mountain. That is not a surprising pattern. Selling a residence (most of these people own their homes) is not easy, especially when the area is under threat. In fact, the field staff informally was told that some homes had been sold for taxes and other homes were for sale but not being sold in areas most clearly affected by the mountain. This was at a time when interest rates were relatively reasonable, so the general market for home sale was not the source of the problem. In short, it may well be that the families could not consider the option of a major move. That left them with trying to determine how best to continue their lives in their current homes.

Although comparable data on search for information was not obtained in the Natural Hazards project, people were asked whether they tried to confirm that a threat existed after they became aware that a warning had been issued.

That confirmation behavior is somewhat similar to trying to get better information on how the mountain might act in the future. Warning confirmation attempts were reported by between 42 and 61 percent of the hurricane site respondents, between 37 and 69 percent of the tornado respondents, and between 11 and 41 percent of the flash flood respondents.

The data from Table 4.9 show that between 42 and 70 percent of the Mt. St. Helens respondents sought more information about the mountain. These figures are quite compatible with those from the hurricane and tornado sites. These consistent similarities between the Mt. St. Helens reactions and the other natural hazard reactions imply that there are basically similar processes at work, regardless of the type of threat. Across-site differences presumably relate to differential risk from one site to the next.

DECISIONS

As with the household survey respondents, family members were asked whether they evacuated, discussed evacuating, or discussed moving for each of five time periods: before the May 18 eruption, after that eruption, and after the subsequent eruptions on May 25, June 12, and July 22. The percent of husbands, wives and teenagers who indicated that such actions were taken are shown in Table 4.10.

TABLE 4.10. Actions Taken, by Time

Time	Evacuated			Discussed Evacuating			Discussed Moving		
	H	W	T	H	W	T	H	W	T
Before May 18	1.7	1.7	0	0.0	5.0	1.7	1.7	3.3	5.0
May 18	1.7	1.7	5.0	10.0	28.4	15.0	6.7	8.3	8.3
May 25	1.7	1.7	1.7	3.3	6.7	3.3	3.3	6.7	3.3
June 12	1.7	1.7	1.7	1.7	6.7	1.7	5.0	3.3	1.7
July 22	0	0	0	3.3	5.0	0	6.7	5.0	1.7

In general, the data in Table 4.10 agree well with the Survey results, and show only minor variations across husbands, wives, and teenagers. Only a few of the Interview families actually evacuated, although there is some minor disagreement about whether that occurred or not. Of course, it is possible for a member of the family to evacuate even though the entire family did not. By far the most common response was to discuss evacuating, especially after the May 18 eruption. Here there is a very sizeable discrepancy between the wives (28.4 percent said they discussed evacuating) versus the husbands (10 percent said they discussed evacuating). Since the question asked whether the family discussed evacuating, we can conclude either that there was differential participation in the discussion or that husbands and wives do not agree on what constitutes such a discussion. Both of these are plausible interpretations of the data.

Family members were also asked who took part in the discussions, if there were any, after each of the eruptions. Of course, many nonresponses are present because many of the families did not discuss. However, for the data available, Table 4.11 indicates who participated.

TABLE 4.11. Who Took Part in Discussions, May 18

Took Part	Husbands	Wives	Teenagers
Husband	16.7	30.0	26.7
Wife	16.7	28.4	26.7
Teen	13.4	18.3	23.3
Other Children	13.4	18.3	10.0
Others	5.0	5.0	8.3

Again, we find the by-now-typical pattern of wives and teenagers providing higher response rates than did husbands. For example, almost twice as many wives say that their husbands took part in discussions than the husbands themselves say they did. A similar discrepancy appears regarding whether the wives took part in such discussions. Interestingly, the teenagers more nearly agree with their mothers than with their fathers on this item. Also, teenagers see themselves as participating more than either parent does. It would seem that there is a lack of consensus on what constitutes a discussion or who has taken part if one has occurred. Either the husbands are dismissing what the wives and teenagers consider to be discussions, or they do not take part in them and are unaware of them. However, the latter interpretation does not agree with the data from the wives and the teenagers about husband participation. Although it is not uncommon for research on family decision [illegible] to find some degree of discrepancy within families, these data indicate that such will occur even when the decisions are extremely important.

Who was responsible in the final analysis for whether the family would move or not? Family members were asked whether anyone in the family had been particularly responsible for deciding whether the family would stay or move. Again analyzing husbands, wives and teenagers separately, between 60 and 71 percent of respondents say that no actual decision was made by the family. That is, although a move did not occur, it was not a deliberate choice but rather a lack of a decision to do anything else. Whether apathy or indecision is to blame [illegible].

Women see more involvement of themselves in the decision than their husbands credit them with, parallel to patterns discerned previously, and teenagers see more dominance of their fathers in the decision process than

either of the parents do. About 30 to 40 percent of the families did make some sort of decision, with the predominant responsibility going to one or both of the parents. These figures would seem to agree reasonably well with the proportion of families who respond to natural hazard warnings of other kinds. Most people appear to be inactive by default rather than carefully selecting an optimal course of action.

Family members were also asked whether moving would create difficulties of various types. In particular, would a permanent move create difficulties for work, for friendships, for school, and for a place to live. The same response options were provided as for the search behaviors reported earlier. Table 4.12 shows the percentage of husbands, wives and teenagers who said there would be some, quite a bit or a great deal of difficulty if a move occurred. For the parents, the two major problems appear to be work and a place to live. [illegible], 60 percent of the wives indicated that a move would create difficulty for a place to live. These data suggest a very large source of inertia for families faced with a continuing environmental hazard. It is simply difficult to imagine not having problems in these areas if a major move is made.

TABLE 4.12. Moving Would Create Difficulties

Difficulty	Husbands	Wives	Teenagers
For Work	40.4	36.7	29.7
For Friendships	22.0	28.3	42.4
For School	17.3	17.3	36.6
For Place to Live	46.5	60.0	45.8

Percent stating "some," "quite a bit" or "a great deal."

Teenagers see the situation slightly different from the way their parents do. In particular, teenagers see much more likely difficulties with friendships and with school than do their parents. Work poses the least problem for the teenagers, as might be expected. The data suggest that, to the extent that the members of the family attempt to discuss a possible move, they will be bringing different priorities to that discussion. In any event, the reluctance to consider moving which was previously demonstrated is understandable in light of Table 4.12. Also, the lack of actually making a decision may reflect the feeling that there is no alternative, hence no decision to be made.

Although it was not anticipated that family members would be very accurate in their estimates, an attempt was made to determine what level of expense each family member thought would be incurred if the family moved. Four types of [illegible] were specified: in terms of a job, moving belongings, housing, and other economic costs. Dollar estimates in these areas were added to get an overall estimated cost of moving. These estimates provide the following averages: husbands, $50,000; wives, $16,500; teenagers, $7,000. There are huge discrepancies in these figures. It is, of course, not surprising that teenagers are relatively unaware of overall cost factors. The large difference between husbands and wives, however, is surprising. Some of the higher cost estimates were from respondents (especially husbands) who stated that it would be impossible to sell the current house or business. Therefore, a huge loss of equity was expected if a move was made.

It would be inappropriate to put large emphasis on these estimates, since it is very difficult for people to make them accurately. The main story they tell is that the data on which members of the same family attempt to make family decisions differs widely from member to member. Whereas

husbands consistently see less risk in staying where they are, they also see greater costs in moving and greater difficulty in finding work elsewhere.

What about the probability that the family would move for good? As with the Survey households, each family member was asked to estimate that probability. Mean probability estimates from the first interview (six months) are as follows: husbands, .10; wives, .08; and teenagers, .17. For the second interview (twelve months), mean estimates are: husbands, .10; wives, .21; and teenagers, .15.

It will be recalled from the previous chapter that the mean probabilities of moving for good were approximately two-thirds to one-half the risk ratios calculated from the probability of eruption and the probability of threat if the mountain erupted. Those ratios continue to hold for the family data, with the exception of the husbands and wives during the first interview. The much larger probability of threat estimates that contributed to larger risk estimates has created a considerably greater discrepancy between risk and probability of moving in those two instances. That the probability of moving did not also increase indicates relative dissociation of a decision to move from a perception of risk.

Second interview data show that the wives see a considerably larger likelihood of moving than do the husbands, with teenagers between the two. Throughout the analysis of risk, wives have been more bothered by the mountain than have their husbands. Again, if husbands and wives participated equally in a decision about moving, the wives would more often opt for leaving and the husbands would opt for staying. We do not have direct evidence of whether any serious confrontations occurred during such discussions, but we do know that husbands and wives did not even agree on the extent to which discussions took place. There is a strong hint of conflict here, whether overt or not.

Finally, a look at the "last straw" data shows responses very similar to those obtained from the household survey. The most commonly stated "last straw" that would get people to move is a severe natural event: further eruptions, floods, or earthquakes. Although some respondents give answers that are job, economy, or health related, most people consider that a "last straw" would have to be a fairly cataclysmic occurrence in order to force them out of their homes.

STRESS

As noted previously, two kinds of stress data were obtained from the families. First, the typical life events stress items were asked, and a summary scale created from those items. Secondly, a new technique called a stress graph was used. Because that technique requires more extended discussion, it will be presented in the next chapter. We will, however, report mean scores on the objective event scales at this time.

Table 4.13 provides mean life event stress scores for husbands, wives, and teenagers in each of the three locations. Scores are also presented for three time periods: before the May 18 eruption, after the May 18 eruption, and during the second interview (between six and twelve months after May 18). It should be remembered that there are 20 families per location on which to base the means before and after May 18, and only 10 families per location for the third stress scores. As with the Survey data, items were not differentially weighted but simply counted if they occurred.

The most obvious aspect of the data in Table 4.13 is the previously observed pattern of considerably elevated stress at the time of the May 18 eruption with subsequent return to a lower earlier level. There are two ways in which the data differ from the Survey data presented in Chapter Three. First, all means are somewhat higher than those presented earlier. Only

TABLE 4.13. Mean Life Event Stress Scores, by Site

	Pullman			Yakima			Longview-Kelso		
	H	W	T	H	W	T	H	W	T
a. Complete Scales									
Before May 18	1.40	1.60	1.85	1.45	2.10	2.25	1.90	.70	1.05
After May 18	3.75	3.40	4.25	2.40	3.45	2.85	3.75	4.20	4.75
After Six Months	.80	.75	1.00	.85	1.35	1.30	1.45	.90	1.30
b. Seasonally Adjusted Scales									
Before May 18	1.15	1.60	1.40	1.20	1.85	2.05	1.50	.65	.90
After May 18	2.50	2.30	3.35	1.90	2.75	2.35	2.80	3.05	3.60
After Six Months	.55	.70	.80	.70	1.20	1.00	1.00	.70	.90

the scores in the first portion of the table should be compared with the Survey mean stress scores, because they depend upon the entire set of stress items. The second portion of the table contains scores computed on a reduced set of items. In particular, all items pertaining to entering, leaving or changing school were removed because those items occur predominantly during the period covered by the second stress score (after May 18). In order to avoid an artificial difference in mean stress before and after the eruption, those obviously seasonal items were removed. The overall effect of the seasonal adjustment is to lower the mean scores without changing their pattern.

The main way in which the stress scores do not show the distance gradient apparent in the Survey data is that Pullman scores tend to be as high as, or higher than, those from Yakima. For the period after May 18, Longview-Kelso scores are clearly highest for all family members, in keeping with earlier results. Also, as with the Survey sample, the mean scores are higher after the May 18 eruption than either before that occurred or some six months later.

It would be convenient to attribute that time-based change to the effects of the mountain, and some of the evidence presented in Chapter Three suggested such a conclusion. However, the ten control families from Minneapolis show a very similar pattern of increase over that time period. The Minneapolis stress scores are somewhat lower than those from Washington State for all family members and time periods, which is consistent with the volcano affecting the scores. Seasonally adjusted scores from Minneapolis nevertheless show increases after May 18 comparable to increases in the Washington State sites. We did not re-interview the Minneapolis families, so do not have a third time period for measuring mean stress.

It is not possible to tell at this time why all sites show elevated scores on presumably objective, nonseasonal items. There are some remaining items which could be seasonal, such as retirement, but that should be very unlikely for samples in the age range observed. In fact, we have no clear interpretation of the over-time change in the control sample. Apparently there is some source of variation in life-event items which needs to be explored further. That the mountain has apparently had some effect is evident from the fact that all Minneapolis mean scores are lower than their Washington State counterparts. However, the seasonal variation in those scores is essentially comparable.

One possible answer lies in the difficulty we had in obtaining the Minneapolis sample. As in the other sites, random digit dialing was used with prefixes in the designated sampling areas. For Washington State, that procedure readily generated an adequate number of eligible and willing cases. In contrast, we had to make over 200 calls in the Minneapolis area to obtain 10 eligible and willing families.

In part, presumably, Minneapolis residents thought that being interviewed for a study of Mt. St. Helens was pretty silly. Telephone callers did stress that we needed comparison families who had not experienced the effects of the volcano, but it is still possible that the request sounded questionable. In any event, a plausible consequence of such reluctance was that only families experiencing currently elevated stress might have been sufficiently motivated to take part. If so, the most recent period (after May 18) would likely have more stress than some earlier period (before May 18), without the mountain's activity being responsible in any way. Such an explanation is, of course, purely speculative.

Again, remembering that these items are presumably objective event records, it is reasonable to expect that members of the same family will show close agreement on their stress scores. Table 4.14 addresses that question. Each three person family contains three dyads: husband-wife, husband-teenager, and wife-teenager. The table contains the zero-order product moment correlation for each of those dyads for each of the three time periods, using all 70 interview families. Note that, prior to May 18, stress scores showed quite low correlations. That fact may be attributable to the fact that data from before May 18 required considerable effort to recall. Because first interviews were approximately six months after May 18, any information from before the eruption would be harder to remember than post-eruption data. The correlations uniformly increase after May 18, to the .5 or .6 level. These are still not large correlations, in that only about one fourth to one third of the variance of the stress scores is common variance. If these are objective events, do we attribute moderate correlations to faulty recall or to lack of awareness among all family members of the same events? Looking to the second

interview data, we find that again the correlations have increased with the exception of the wife-teenager correlation. In general, the second interview correlations are reasonably strong, suggesting between one third and one half common variance in the stress scores.

TABLE 4.14. Dyadic Correlations of Stress Scores, by Time

	H-W	H-T	W-T
Before May 18	.29	.20	.30
After May 18	.54	.51	.60
Second Interview	.59	.73	.57

All entries are significantly nonzero except for H-T before May 18.

Altogether, the analysis of the stress scores poses important theoretical problems. First, the scores show a pattern of change over time which does not seem obviously related to the volcano or to other readily discerned causes. Second, the stress scores respond to proximity to Mt. St. Helens, in a manner which indicates that presumably objective events can be affected by an environmental stressor. Finally, members of the same family provide only moderately correlated accounts of the same set of stressor events. If family stress research is to continue to use life events stress scales, then it will be necessary for these questions to be addressed in future work.

COPING

Because the family interview coping data are so similar to data observed in the household survey, only brief commentary will be necessary at this time. The chance to observe the family data allows determining whether there are age-sex specific coping patterns or a more general trend across all categories of respondents. As is evident in Table 4.15, there is more a general pattern than an age-sex specific one.

First, the items appearing in Table 4.15 are essentially those which showed significant change in Chapter Three. Secondly, some of the changes are more pronounced in the family interview data than was the case in the Survey data. Comparisons are made here only for the change recorded in the first interview, because only half the families were re-interviewed. Consequently, the number of cases available for calculating percentage changes would be considerably smaller for the second interview family data.

Note that the largest and most dramatic percentage change is somewhat spurious. That is, 80 percent of the teenagers indicate increased planning for the future. However, given that stage in life, such an increase is to be expected regardless of the activities of Mt. St. Helens. High net percentage changes also appear for a number of items emphasizing positive reaction to the volcano's threat. In particular, social activities and planning for the future increase in response to the volcano. Being thankful and believing in God imply a positive attitudinal response, while relatively few of the escapist or nervous tension type behaviors gained significant change in percentages. Reading is the one consistent escapist activity which has large percentage increases, although it is possible that some of that reading had to do with learning more about the mountain and how one might react to it.

TABLE 4.15. Percent Changes in Coping Behavior

Behavior	Husbands	Wives	Teenagers
"Social"			
Talking about feelings	+22*	+38*	+25*
Talking with family	+32*	+48*	+25*
Relating to others	+20*	+30*	+47*
Attending gatherings	+ 5	+20*	+35*
"Vice"			
Smoking	- 2	+10*	+ 3
Prescription drugs	0	+12*	+ 2
"Escape"			
Reading	+27*	+33*	+25*
Hobbies	+12	+17*	+22*
Dieting	+12	+18*	+ 2
Daydreaming	+12	0	+20*
Traveling	-10	-12*	- 8
"Feeling or Showing Emotion"			
Being angry	- 7	+15*	+ 3
Being thankful	+43*	+63*	+48*
Keeping problems to self	-10*	- 7	- 5
Showing strength	+ 7	+25*	+22*
"Solving"			
Planning future	+37*	+35*	+80*
Finding out about other jobs	+ 8	+10	+23*
"Religion"			
Believing in God	+15*	+28*	+35*

Percentages are based on 60 individuals, and representative net change (percent "more" minus percent "less").

*Probability less than .05 that the observed net change will occur among the observed number of "more" and "less" answers, if "more" and "less" were equally likely.

There are some hints of age-sex differences, partly indicated by the greater number of asterisks in the "wives" column than in either of the other two. What seems particularly remarkable is that there are as few differences as appear in the table, even between teenagers and their parents. These data, coupled with the Survey data, suggest quite predictable and generally positive modes of response to a continuing threat such as an active volcano.

The only remaining item from the family interviews which parallels data from the household survey is the extent to which the first interview was seen by the respondents as affecting their behavior after that interview. The three items were whether the respondent talked with the family about the mountain more after the first interview, whether the respondent talked with others more about the mountain after the first interview, and whether the respondent had different feelings due to the first interview. Responses by husband, wife and teenager to these items show very little variation. Sizeable percentages said yes, from 30 to 47 percent, indicating a third to a half of the respondents did find that the first interview had influenced their subsequent actions or feelings. These percentages are comparable to those from the households survey, with the exception that slightly higher percentages of family members reported changes in feelings.

SUMMARY

For the most part, the families studied in depth are sufficiently comparable to the Survey households that comparisons between the two are appropriate. In general, families experienced considerable difficulty due to the mountain, and indicated a fair degree of concern over the mountain. However, decision-making information suggests relatively little direct attempt to escape from the consequences of the volcano. Instead, the most frequent responses dealt

with getting more information about the mountain and about how to protect against its effects. Sizeable proportions of the family members saw that a permanent move would create problems. Life stress scores increased after the May 18 eruption, and a variety of mostly positive coping behaviors also increased. The general picture is that the families behaved in ways very similar to the larger survey household sample families.

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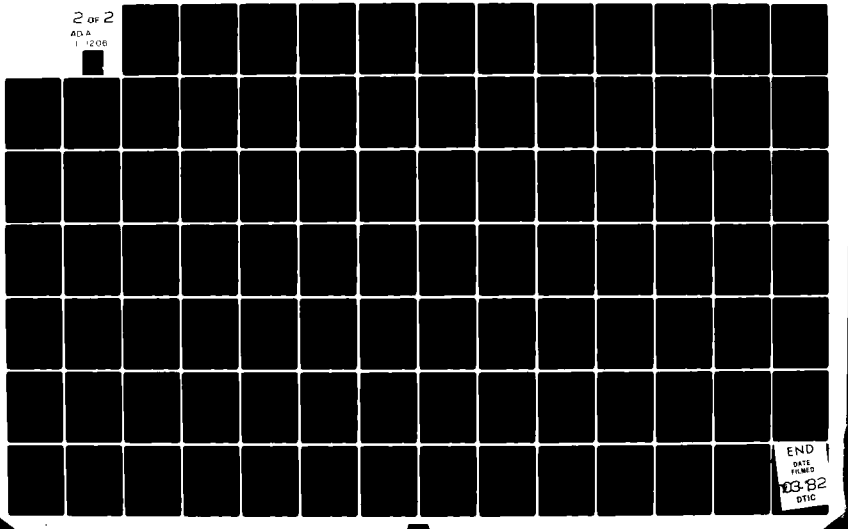


Chapter Five

STRESS GRAPHS

ABOUT STRESS GRAPHS: A NEW TECHNIQUE

There are two difficulties with typical ways of measuring stress. First, the most common procedures deal with objective events which are presumed to create stress, rather than with subjective indications of stress actually felt by the people under study. Secondly, only a single measure of stress is provided rather than relatively continuous measurement over time. That is, a life events type of stress score is a single score covering all events that have occurred over a considerable period of time. By contrast, it would be desirable to have an indication of how much stress was felt across time so that variations in stress could be assessed and attributed by observable events. The stress graph procedure to be described in this chapter was developed specifically to resolve these two problems. There is some precedent in earlier work by Bourque and Back (1977).

The graph itself is a very simple set of coordinate axes drawn on graph paper. Although what will be described was developed specifically for the Mt. St. Helens project, it is apparent that the procedure is readily adaptable to other over-time stress measurement. The horizontal axis is a time-specific axis. For this project, time had been marked off in months and the five major periods of volcanic eruption were indicated on that time scale. Thus, May 18, May 25, June 12, July 22, and October 18 were all indicated by small arrows along the time (horizontal) axis. We have not analyzed the data in terms of the October 18 eruptions because many of the interviews were completed before that time, so that marker did not appear on the graph at the first interviews. Of course, all earlier markers were on the graph.

For other applications of the stress graph, it would be desirable to have some standardizing time point that allows the respondent to key periods of high or low stress to identifiable events.

There is a question of the ability of respondents to remember stress levels over a period of time as long as that covered by this graph: approximately six months. Presumably, minor variations in stress from day to day would not be remembered for that length of time, nor could they accurately be recorded on such a long-term graph. On the other hand, the longer time interval covered by the graph should allow periods of major stress or of relatively low stress to be identifiable. That is, it is assumed that small, refined detail will be lost with this length of time whereas major changes in stress levels will be adequately recalled.

A second difficulty with this type of procedure is that individual respondents will [illegible] high and low points on the graph according to their own experiences. Those experiences may not coincide in time with other individuals' experiences, hence summarizing data from graph to graph will be difficult. That is, there will not be the same points in time from one person to the next to allow easy summarizing of the data. To accommodate this difficulty, an interactive computer program was prepared which allowed the data points specific to an individual's graph to be entered as coordinates on the graph. Then, using linear extrapolation, a set of standardized time point scores were calculated, providing 39 data points for the first interview stress graph and 31 data points for the second graph. Because some points from the second graph overlapped time covered by the first graph, and because minor changes in the horizontal (time) scale were made to make the May 18 and May 25 eruptions more readily distinguished, the procedure resulted

in approximately one time point per week recorded in the data file. It should be noted that although linear extrapolation was used, it was easy to represent curves by virtue of a sufficient number of entered coordinate points.

The vertical scale of the graph was simply labeled "Stress," and showed values from zero to ten. The manner in which stress was defined for the respondents, and the way in which they were asked to assign values on the graph to their perceived stress levels, is best indicated by quoting the interviewer instructions.

> Now I would like you to try something different. Most everyone feels some degree of stress from time to time. At times you may feel no problem with anything. At other times things seem to pile up and you really feel tense, angry or even afraid. Let's call all of that "feeling under stress." I would like you to figure out a graph of how much stress you have felt over the time that Mt. St. Helens has been acting up. It might have been due to the mountain or due to other things altogether. We're talking about all kinds of stress.
>
> It's not very difficult. First, look at this blank graph and decide at what time you really felt MOST "uptight," regardless of the reason for the stress. Was it AT or JUST AFTER one of the eruptions, BEFORE THE MAY 18 ERUPTION, or at some other time. Find that time on the TIME LINE of your graph.
>
> Next figure out how much stress you felt at that time. If it was a lot, put a mark close to the top of the graph (maximum stress = 10). If it was moderate, put the mark about half way up (around 5), and so forth.
>
> Now think about when you felt the LEAST stress. Find that time and figure out how high up on the graph your mark should be for that time.
>
> Keep working along, filling in points showing about how much stress you were under for different times since BEFORE the mountain began kicking up, RIGHT UP TO NOW. Finally, when you have as many points as you can be fairly sure about, draw a line or curve through the points showing how your level of stress has gone up and down these past few months. Remember, this is YOUR graph. When you have finished, look it over to see if it looks right. If not, make any changes you think are needed.

There are questions raised by the use of subjective scales. The most difficult question concerns the extent to which individual norms vary from person to person and influence the across-person comparisons of such data. For example, one individual may assume that moderate stress has a value of 2.0, whereas someone else may assume moderate stress is 6.0. For this reason, overall individual means and variances were computed, and will be used to standardize individual scores for certain portions of the analysis. On the other hand, raw scores will be used for many of the analyses as well.

BASIC RESULTS

A single graph containing the overall mean (unadjusted) scores across all family members and all sites is presented in Figure 5.1. A few comments are appropriate. First, there is an obvious peak in the graph around May 18. That is, the major eruption which occurred at that time obviously influenced all or most of the respondents sufficiently that the overall mean is elevated for that time period. Secondly, there is no evidence of similar peaks for the other eruptions: May 25, June 12, or July 22. It is possible that the May 25 eruption is masked by the more prominent event one week earlier, but the June and July points do not appear. There is a subsequent peak around mid-November, which does not coincide with any eruption of the mountain. As will be shown, that peak is attributable primarily to respondents from Pullman.

No data point has been plotted if it is based on six or fewer cases. That is to avoid unnecessary fluctuation in the curve because of averaging across too few data points. Individuals, of course, did not necessarily begin drawing their graphs at the time boundaries of the blank graph, but instead drew stress lines over the time period for which they felt some

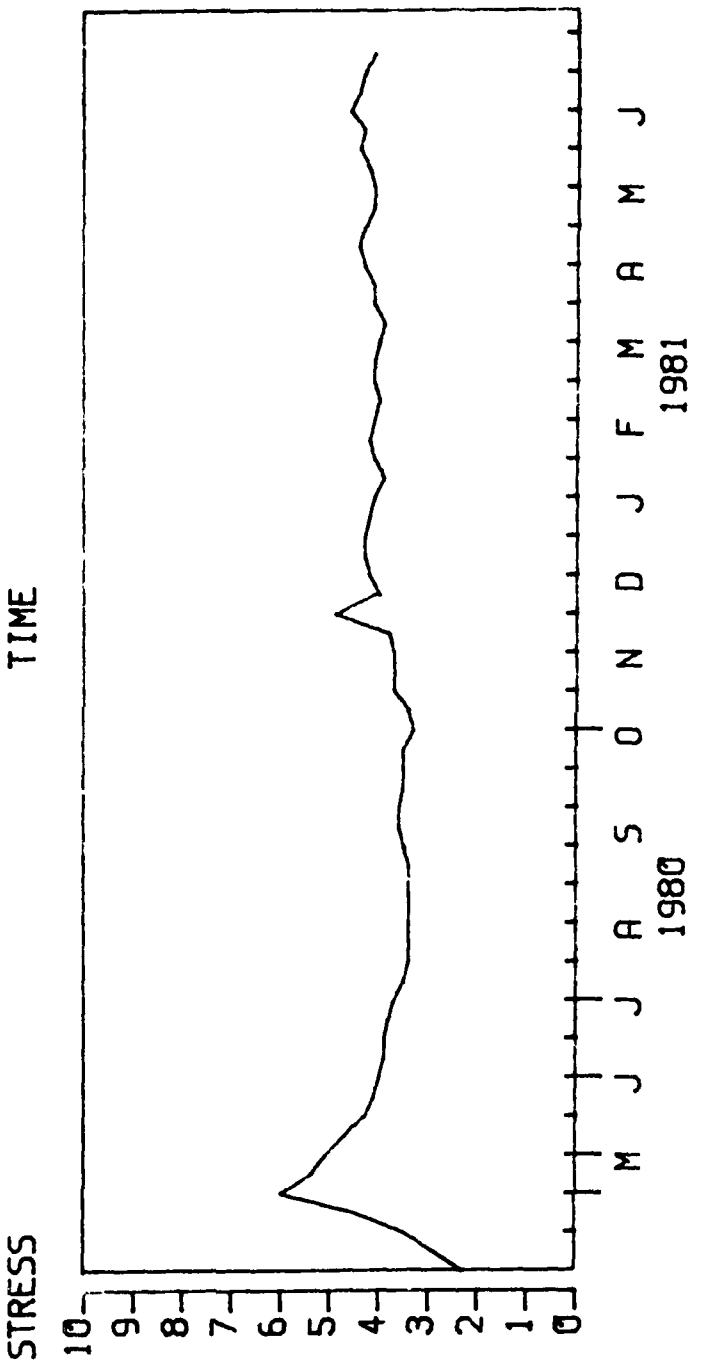


FIGURE 5.1. Mean Stress Curve Over Time

confidence in reporting their subjective stress levels. Consequently, some points on the summary graph would be represented by very few cases if the criterion of minimum denominator were not imposed.

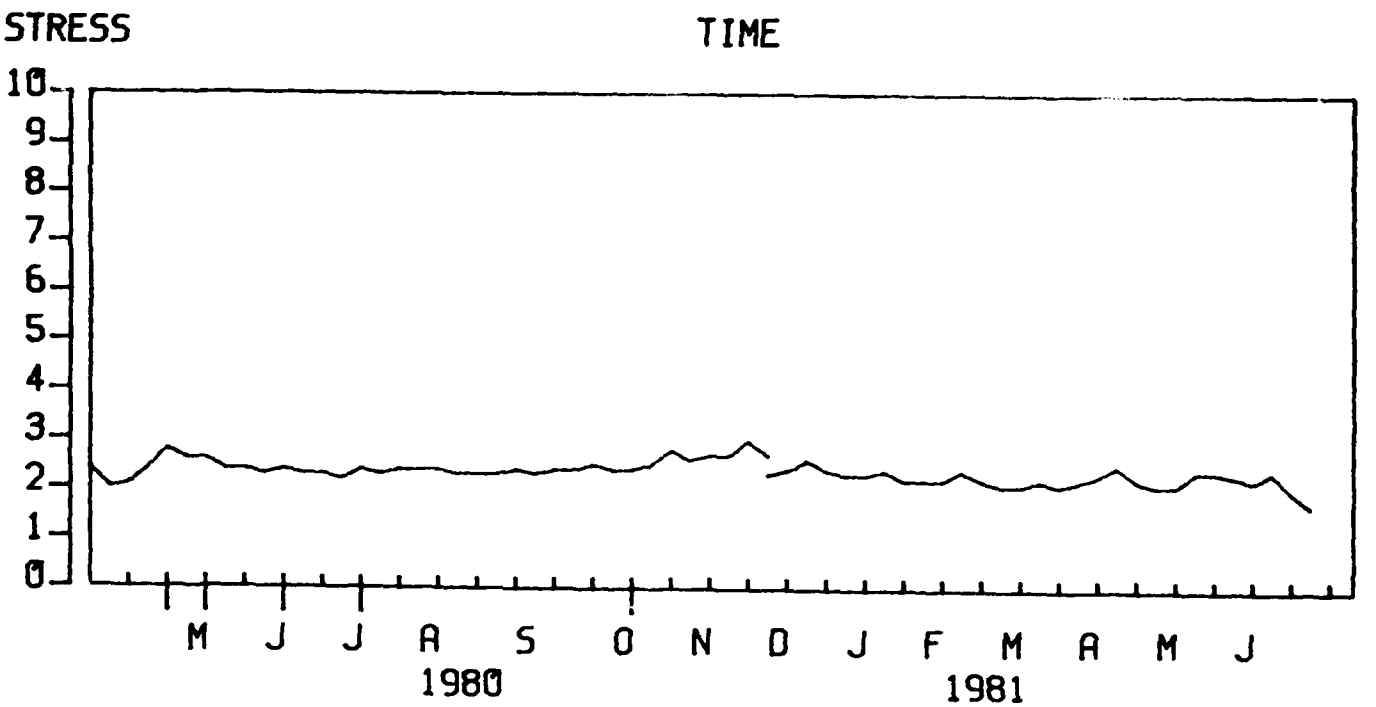
To what extent does the stress score vary across people at a given time? To examine that question, a graph was prepared containing the standard deviation of stress levels across respondents at each time point. Figure 5.2 contains those data. It is apparent that not only is the standard deviation quite low, meaning not too much variation across individuals, but also that the standard deviation shows little variation over time. There is a minor increase in the standard deviation at the time of the May 18 eruption, indicating some greater variability in response to that unique event. In general, however, the variability of stress data seems remarkably consistent.

COMPARISONS OF MEAN STRESS LEVELS

In order to examine further whether the stress graph is measuring relevant effects, we will look at average curves by family role (husband versus wife versus teenager) and by location (Pullman versus Yakima versus Longview-Kelso). Figure 5.3 shows the family role curves. Note first that the wives show higher levels of stress at the time of the May 18 eruption than do either husbands or teenagers. This fact coincides with data from Chapter Four. They also show elevated stress levels in the November to January period, primarily due to the Pullman respondents. Husbands and teenagers show very similar responses for the entire period. All three curves are very close for a large portion of the time under study.

Figure 5.4 contains all cases grouped by location. The first obvious aspect of Figure 5.4 is the Pullman elevated stress level apparent at the end of 1980. In addition, the Longview-Kelso curve is somewhat higher at the time of the May 18 eruption, and noticeably higher from October through

FIGURE 5.2. Standard Deviation of Stress Curves Over Time



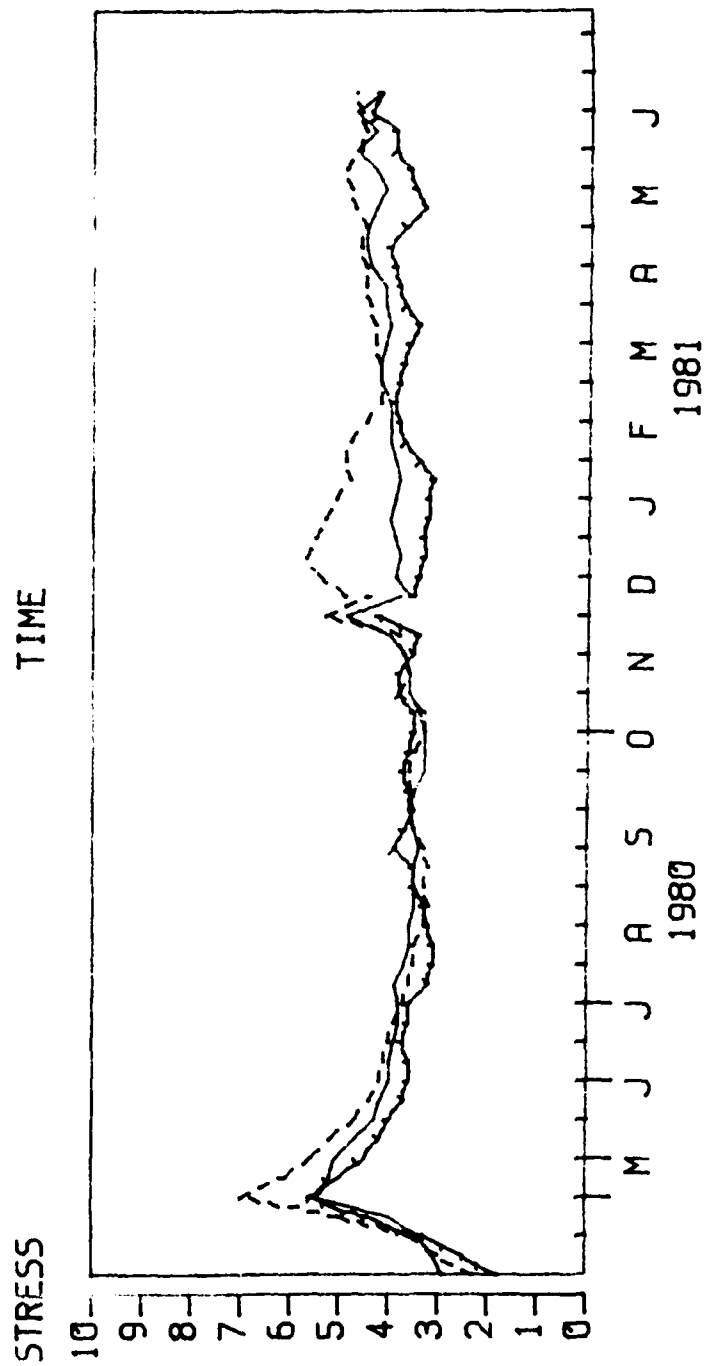


FIGURE 5.3. Mean Stress Curves of Family Roles Over Time

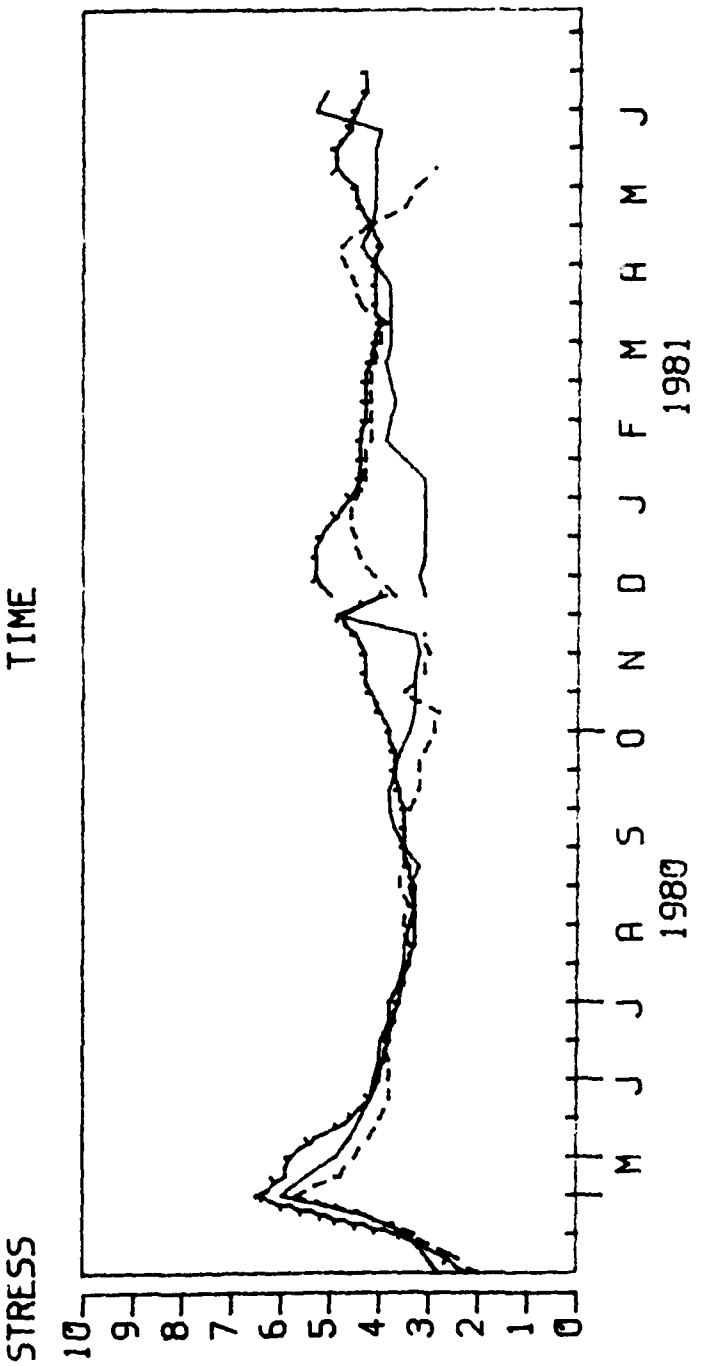


FIGURE 5.4. Mean Stress Curves of Three Sites Over Time

January. That latter difference is particularly indicative of the ability of the stress graph to measure relevant effects. During that time, federal officials were warning the towns of Longview-Kelso that they may need to evacuate thousands of households because of threat of massive flood. Had normal rains and snows occurred late fall and early winter, such evacuation would have been necessary. In fact, abnormally low moisture levels occurred, and evacuation did not take place. However, the threat to the area is evident in the figure.

What about various combinations of family role and location? Husbands by location are shown in Figure 5.5. It is clear that the men in Longview-Kelso were most bothered by the eruption on May 18 and continued to show higher stress levels longer than did men from the other communities. Secondly, the flood threat for the Longview-Kelso area appears clearly from November through January. Yakima men display somewhat higher stress scores than do Pullman men after October, 1980. In fact, the entire time covered by the second interview shows a clear distance effect from the mountain. That is, Longview-Kelso shows the highest levels, Yakima next, and Pullman the lowest. As noted before, the peak in November in the Pullman graphs appears for the husbands in the Pullman area in Figure 5.5.

The next figure examines wives by location. As is evident in Figure 5.6, there are similar responses to the May 18 eruption, except that the Longview-Kelso wives show a somewhat longer period of elevated stress due to that eruption. Again, the peak in the Pullman curves appears in November, and the Longview-Kelso curve is much higher from late November through December, indicating the flood threat for that area. The curves finish quite similarly.

Finally, Figure 5.7 shows teenagers by location. There are no surprises in these curves compared to the curves for the parents, in that the response to the eruption of Mt. St. Helens is quite similar, the elevated curve for Pullman appears in November, and the patterns seem quite familiar.

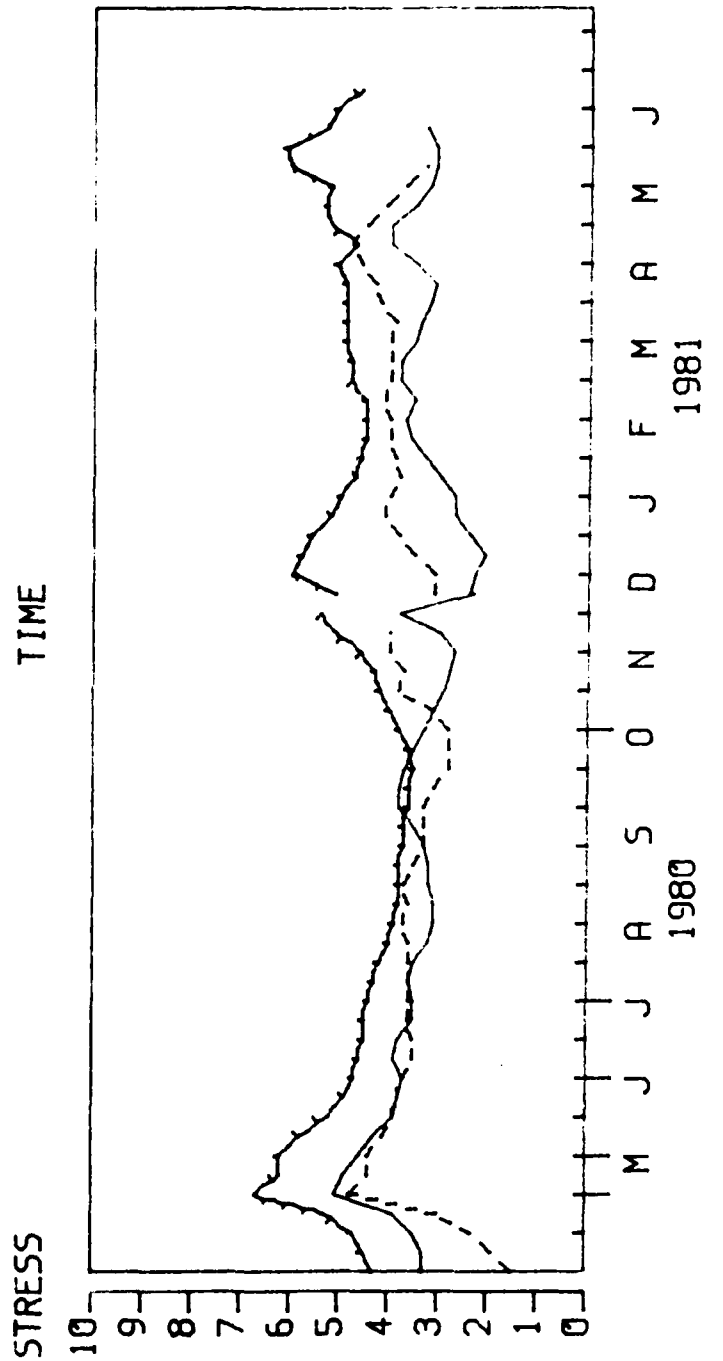
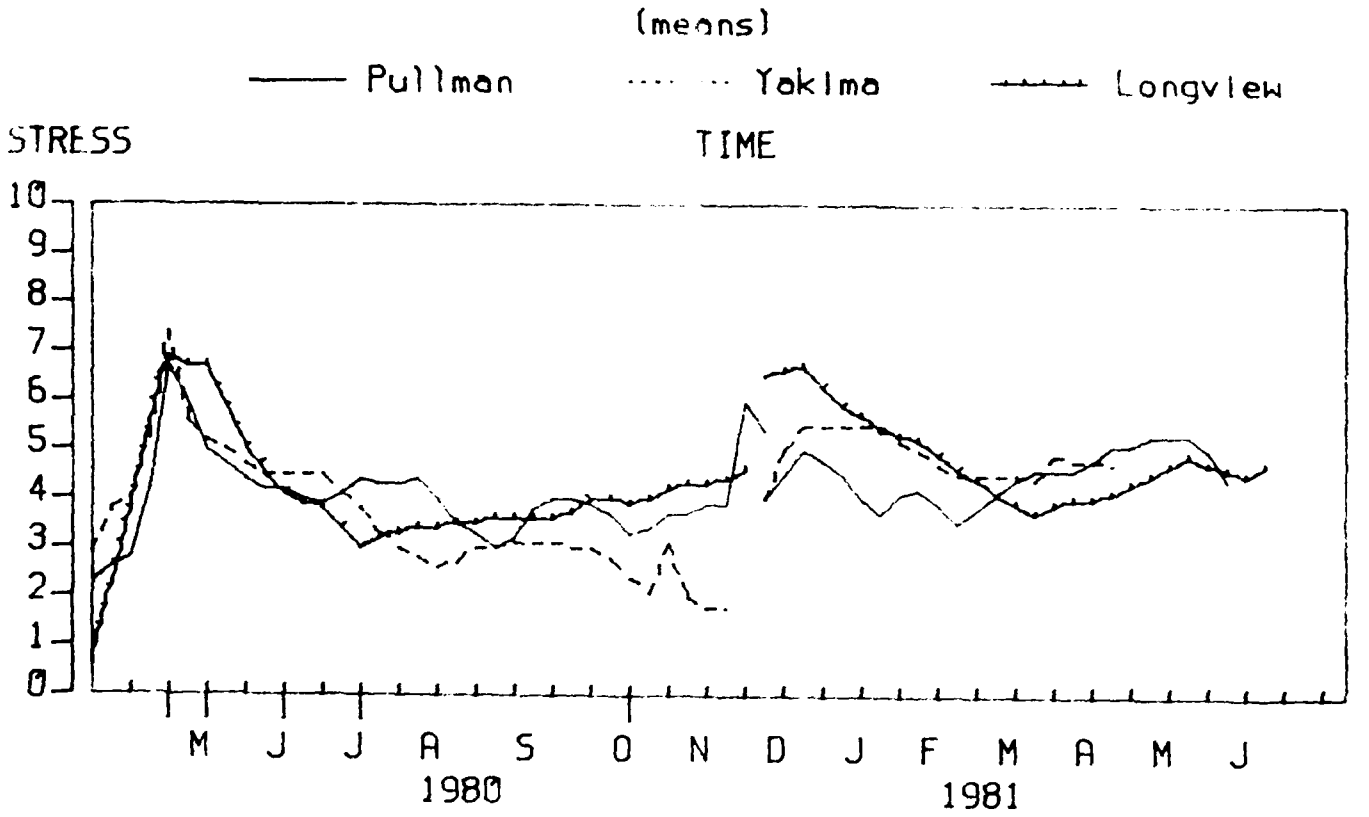


FIGURE 5.5. Mean Stress Curves of Husbands Over Time, by Site

FIGURE 5.6. Mean Stress Curves of Wives Over Time, by Site



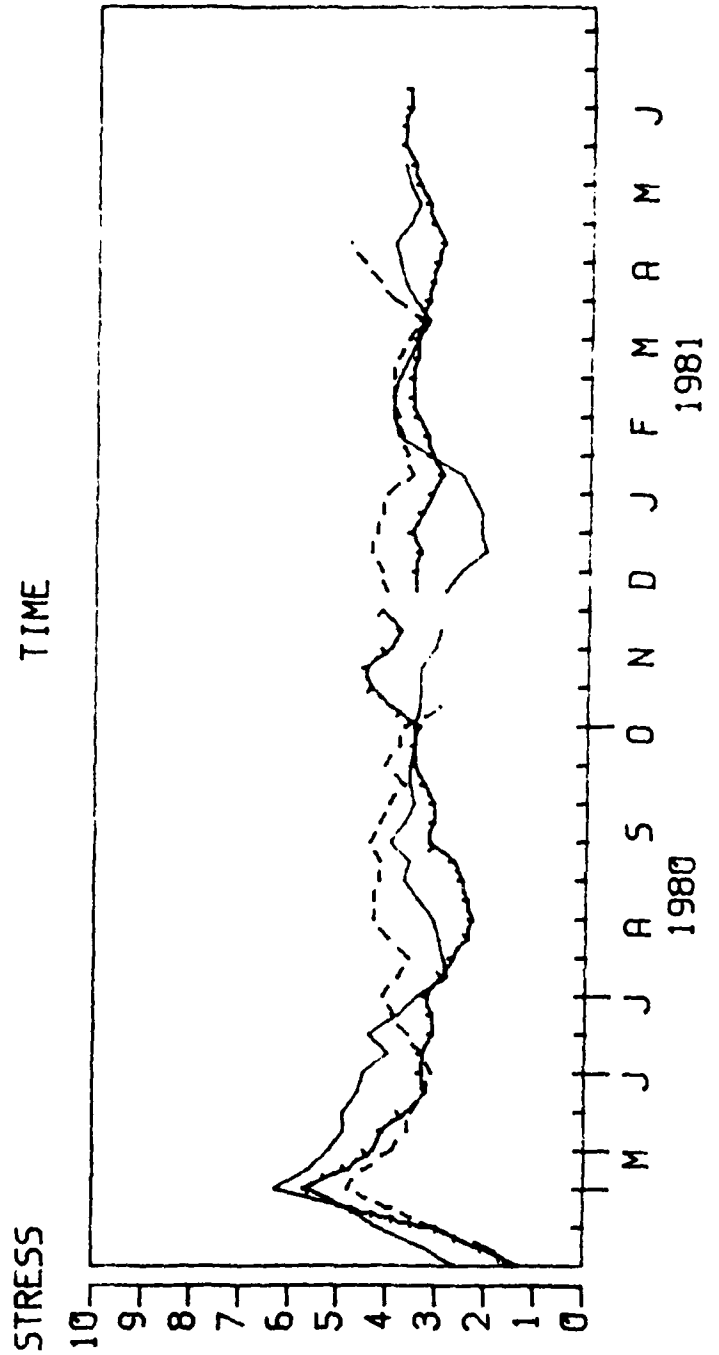


FIGURE 5.7. Mean Stress Curves of Teenagers Over Time, by Site

To summarize this section, it is apparent that there are some important differences by location, and some other differences between husbands, wives, and teenagers. With the single exception of the elevated stress in Pullman during November, 1980, all variations are reasonable in terms of the events being studied. That is, the stress graph seems to serve its purposes well.

Regarding the anomalous elevation of stress in Pullman, we have not as yet discovered the reason for that pattern. Apparently, some event or events not captured by other questions disrupted a number of people in that particular community. Presumably, whatever that cause was bears no relationship to Mt. St. Helens. The plausible interpretation is a shared stress due to the presidential elections, which may have been far more intensely followed by the liberal-oriented faculty than by most other populations. It should be noted, by the way, that standard deviations for all cases grouped by family role (husbands, wives, teenagers) and by location (Pullman, Yakima, Longview-Kelso) provide almost indistinguishable curves. That is, those variables do not exert differential effects on the variability of the stress scores.

CHANGES OVER TIME

Although the time changes are apparent in the graphic presentations, it is helpful to examine mean scores within specified time intervals to determine whether the apparent effects in the graphs show up numerically. Five different time intervals were examined: the first ten data points (centered around the May 18 eruption), points 11 through 25 (half of the remainder of the first [illegible] through 39 (the balance of the time covered by [illegible]), points 40 through 55 (the first half of the [illegible]), and points 56 through 70 (the

balance of the second interview time period). Table 5.1 contains mean stress scores by location and family role for each of those five time intervals.

TABLE 5.1. Mean Stress Levels, by Site, Family Role and Time

Time	Pullman			Yakima			Longview-Kelso		
	H	W	T	H	W	T	H	W	T
1-10	4.08	4.52	4.71	3.90	4.89	3.49	5.82	5.35	3.74
11-25	3.47	3.89	3.57	3.54	3.42	3.66	4.10	3.53	2.52
26-39	3.24	3.90	3.57	3.08	2.63	2.42	3.92	4.13	2.72
40-55	3.10	4.23	3.12	3.88	4.90	3.78	4.98	5.19	3.13
56-70	3.42	5.00	3.95	3.91	4.30	4.14	5.13	4.46	3.11

Time is in terms of standardized data points for the stress graphs. Points 1-10 are immediately around the May 18 eruption. Points 11-25 and 26-39 divide the balance of the first interview graph. Points 40-55 and 56-70 divide the second interview graph. Approximate calendar dates are:

Points 1-10	April and May, 1980
11-25	June through Sept., 1980
26-39	Oct. through Dec., 1980*
40-55	Dec., 1980 through Mar., 1981
56-70	April through July, 1981*

*Actual end dates depended upon time of interview, somewhat earlier than December, 1980, or July, 1981.

It is obvious from Table 5.1 that there is a noticeable drop from the first time interval to the second time interval for all locations and family roles. That is, following the May 18 eruption there is a general decline in subjective stress. From the second interval to the third, there is continuing drop for most of the categories of location and family role. However, there is an increase at this time for the Longview-Kelso area for women and teenagers. The next comparison shows increases for seven of the nine columns of data. That shift is from the end of the first interview stress graph to the beginning of the second interview stress graph.

It is not evident from the data whether any of three possible explanations obtains. The first possibility is that a real increase in stress has occurred across time from the first to the second graph. Of course, other evidence indicates an increase in stress for the Longview area toward the end of the first graph, which would be carried over into the second graph. Aside from a true increase in stress, there are two other possibilities. It may be that individual respondents had a change in their own norms from the first interview to the second. That is, without the event of May 18 providing a peak stress reference, normal stress levels may have been recorded somewhat higher on the average in the second interview than they were in the first. It will take a good deal more work with stress graphing to determine whether such scale shifts might occur. The final possible explanation is that the second graph depends upon only half the cases represented in the first graph. That is, only one half of the families were re-interviewed.

The last change, from time points 40-55 to time points 56-70, again shows overall increase in six of the nine columns. The fact that there continues to be a rise in stress suggests that the previous increase was a legitimate change in stress rather than a methodological artifact. It is not clear why stress levels in general would increase across the early part of 1981. After October, 1980, the mountain remained relatively calm, and no other obvious events occurred to increase subjective stress levels. Such changes could, of course, pertain to much broader events such as changes in inflation, unemployment, and so forth.

In general, although some of the changes noted in the previous discussion are not immediately explainable, it is apparent that the stress graphs do show important and consistent effects. The mean values recorded in Table 5.1 simply reflect the graphic evidence in the figures presented

so far. The time around the May 18 eruption does show high levels of stress, with consistent decrease in stress after that time. Stress levels in Longview-Kelso are higher than in the other two sites, at least during the main eruption period. It is convenient that the graphic evidence can be presented either pictorially or numerically so that both visual and statistical analysis is possible.

FAMILY PATTERNS: DYADIC CORRELATIONS

A major focus of the research concerns how families rather than simply individuals responded to the eruptions of Mt, St. Helens. It will be desirable, therefore, to determine the extent to which members of the same family show similar, uncorrelated, or opposing patterns of response not only to the mountain but also to other stress events in the lives of that family. It would be difficult to analyze all three respondents in the same family simultaneously, but relatively easy to examine the three *dyadic patterns* created by three individual family members: the husband-wife dyad, the husband-teenager dyad, and the wife-teenager dyad. Of course, to the extent that two of these dyads are strongly related, there is a statistical constraint upon the third dyad.

Stress scores for the members of each dyad in each family were correlated over the entire set of data points. If either member of a dyad had not recorded a stress level on his or her graph for a given time point, that time point was not included in the computations. Therefore, although reference will be made to correlations computed from points 1 through 70, actual computations include only those points for which both dyad members have scores.

There are alternative ways of expressing correlation coefficients, one of which is most useful for this analysis. First, compute the mean and the

standard deviation for a given person for all data points. Secondly, transform each data point by subtracting that person's mean and then dividing the difference by that person's standard deviation. This procedure produces a z score, or standardized score. A correlation is simply a mean cross product of z scores.

That interpretation of a correlation coefficient aids understanding the partial time relationships that will be analyzed. In order to determine whether the extent of similarity of response to stressors changed over time, partial mean cross products of z scores were computed. For example, products of z scores for a dyad were computed for time periods one through ten, added up, and that sum was then divided by ten. Note that this is not a true correlation, because the overall mean and overall standard deviation were used to create the z score in the first place, whereas only part of the data were used in computing the mean cross product. Consequently, although a correlation coefficient ranges only from -1 to +1, the partial time range coefficients can exceed those limits.

Such partial time range coefficients are preferable to strict correlations over a reduced time range for one reason. If both a husband and wife respond strongly to the May 18 eruption, compared to how they respond to most events in their lives, both will show high curves during that time period. They may not show identical curves of response to the eruption, such as the husband increasing stress somewhat more slowly and maintaining it somewhat longer than the wife within the first ten data points. If a true correlation were computed only on those ten points, then what is in fact mutual high stress could produce relatively low correlations because of minor variations in who when the stress went up or down. If the stress points are standardized on the overall means and standard deviations, however,

the entire range of values for both husband and wife during a period of mutual high stress will be well into the positive numbers, producing a positive mean cross product for that time interval.

Partial time range coefficients for five time intervals plus correlations over the entire range, by family dyad and site, are shown in Table 5.2. The most important fact evident in the table is that, with one exception, all dyad coefficients are high at the time of the May 18 eruption (data points one through ten). It is not evident why wives and teenagers in Yakima show a negative coefficient during that time. Beyond the first time interval, however, there is little consistent relationship by dyad or site. Some of the coefficients in Yakima continue to show sizeable values throughout successive time intervals, suggesting a closer relationship between family members in Yakima in how they respond to events other than a major eruption. For Pullman and Longview-Kelso, however, virtually all coefficients are near zero. The implication, therefore, is that except for a time of major stress, there is little similarity in the over-time patterns of stress of people within the same family.

TABLE 5.2. Mean Dyadic Correlations of Stress Levels, by Site and Time

Time*	Pullman			Yakima			Longview-Kelso		
	HW	HT	WT	HW	HT	WT	HW	HT	WT
1-10	.45	.54	.71	.41	.41	-.10	.50	.59	.33
11-25	.05	.15	.09	.20	.15	-.08	.18	.14	.01
26-39	.03	.01	-.01	.26	.10	.47	.05	.00	.18
40-55	.04	.04	.05	.40	.29	.06	.02	.13	-.14
56-70	.03	.21	.27	.13	.37	.30	-.13	.16	-.22
Total (1-70)**	.14	.20	.19	.31	.25	.05	.21	.21	.14

* See Table 5.1 for explanation of time points.

** Only the total correlations are true correlations. Each data point is standardized around the total mean and the total standard deviation for that individual, producing a z score. Recorded values are the mean cross product of z scores for time points listed.

The total correlations bear out this fact. Despite the strong positive effect of the May 18 eruption, overall correlations vary from small to moderate (.05 to .31), although all remain positive. The overall mean for all dyads and sites is only .19, suggesting that without the influence of the May 18 eruption, members of the same family have very little similarity in how their over-time stress levels vary. That is indeed an intriguing fact.

If individuals of the same family show very similar stress curves, then it means they are responding in the same way to events which impinge mutually. For example, deaths or marriages in the family, outside events like the volcano eruption, and so forth, create similar feelings of stress for members of the same family. That pattern seems to have occurred around the time of the May 18 eruption. It is possible to expect, under certain circumstances, that members of the same family will not experience the same stressors. For example, serious illness of a sibling of one parent may not be a particular stressor for the other parent, for whom that sibling is only an in-law. One possible explanation of the low overall correlations is that there are some of that type of individual stressor events for most families, such that some negative correlation periods appear. In addition, there are also some jointly experienced stressors such that positively correlated periods appear. Over a long enough time period, then, these positive or negative periods would tend to cancel each other out and produce a near zero total correlation.

It is possible, using programs developed for that purpose, to display the stress graphs for all members of a family simultaneously on computer terminals. Examination of those family graphs indicates some validity for the argument just presented. That is, it is possible to find many families with periods of similar stress curves and also with periods of quite dissimilar stress curves. The interesting fact, however, is that not all three members

are likely to show similarity at the same time except for the May 18 period. That is, one event may produce positive correlation between husband and wife, while the teenager shows a quite disparate pattern. At another time, husband and teenager may show similar response while the wife has quite a different pattern. Some specific examples will be provided shortly to illustrate this fact.

Given the dyadic relationships for specific time intervals, it is possible to create a family typology based on whether each of the dyads is positively, negatively or not at all correlated for that time interval. For convenience, let a time period association above .25 be considered a positive dyadic coefficient, below a -.25 be considered a negative coefficient, and between those values be considered uncorrelated. By those criteria, for the time points one through ten, 22 of the 60 families showed a +++ pattern. That is, all three dyads were above a .25 relationship for that many families. For the four remaining time intervals, the number of +++ families was 8, 8, 3, and 2, respectively. Thus the mountain eruption created an extraordinary number of +++ families.

How stable are such family patterns? A formal answer to that question would involve fairly complicated computations, but a reasonable indication is provided by the following simple method. Assign a score of "1" for a + dyad, "0" for an uncorrelated dyad, and "-1" for a minus or negatively correlated dyad. Then add the three dyad scores for a given family. This score can range from "3" for a +++ pattern to "-3" for a --- pattern.

Assume that dyadic relationships are randomly assigned across dyads in a given family and across families, based on marginal probabilities of a +, 0, or - dyad occurring. Given that random distribution assumption, a complete sampling distribution of family scores can be calculated. That calculation

was accomplished via computer, and mean family scores for time periods 1-10, 11-39, and 40-70 were compared. Results of those statistical comparisons show that the amount of change in family score from time period 1-10 (around the May 18 eruption) to time period 11-39 was significantly greater change than would be expected by chance. This result simply verifies the pattern observed earlier of general decrease in the dyadic relationships once the effect of the May 18 eruption had worn off.

The parallel comparison between time period 11-39 and time period 40-70 shows significantly less change than would be expected by chance. This is an unusual form of computation, since it is usually desired to test a hypothesis that two means differ more than chance. However, a sampling distribution includes probabilities for small values as well as for large values. It is possible, therefore, to calculate the likelihood of observing very small changes as well as very large changes. The implication of the result is that, beyond a major event such as the May 18 eruption, family patterns remain quite stable. That is, the extent of correlation across dyads for a given family tends to be quite similar over time. Only major events alter that quite consistent pattern.

The fact of stable dyadic patterns is particularly important when stress graph procedures are applied to major events such as the Mt. St. Helens activities. Inspection of individual stress graphs shows clear individual response to a variety of stressors other than the mountain's behavior. Factors such as illnesses, job losses, drivers license applications by teenagers, and myriad other day-to-day stressors appear in the graphs obtained from the family members. However, these events apparently are insufficient to generate overall positive correlation of the time-based stress curves for members of the same family. On the other hand, the data clearly indicate that the

volcanic eruption produced overall similar response. Thus a major external stressor creates a commonality of subjective stress across members of the same family which is quite unusual compared to normal, everyday life patterns. That common elevated stress provides the most useful focus of attempts to convince families that protective action is necessary to avoid threat. As research on other natural hazards has demonstrated, if threat is not perceived then action is quite unlikely. Our data show that considerable stress was perceived by two or more members of the same family for many of the families studied.

TWO CASE ILLUSTRATIONS

There are numerous interesting details in the stress graphs and their annotations, which could occupy a great number of pages of discussion. However, many of the details would prove identifiable with specific families, hence reporting those details would violate promises of anonymity. Also, such detail is of greater interest for the clinical evaluation of family response to stress than for the specific concern with how families responded to Mt. St. Helens. Therefore, only two families will be presented at this time. One of the families was interviewed only once, hence the curves do not cover the entire form for the combined stress graphs. The other family was interviewed both times, providing more complete curves.

Figure 5.8 contains the graphs for the first family. First, note that the daughter's curve shows only a minor reaction to the May 18 eruption, and remains low beyond that point. Also, the daughter terminates her curve well before the time of the interview. In contrast, both parents' curves show high peaks at the time of the May 18 eruption. In fact, the daughter was not at home at the time of the eruption. The parents expressed great concern over their daughter's safety, while the daughter knew she was in no danger.

Because each curve is standardized around its own mean and standard deviation for computing dyadic correlations, even though the mean stress level of the daughter is quite low, all dyads are strongly correlated across the entire set of time points. The correlations as well as the means and standard deviations appear in Figure 5.8.

Figure 5.9 highlights the first ten data points and provides the partial time period "correlations" for the three dyads as well as the restricted time period means and standard deviations. Note that, especially at this time, all three dyads show highly similar response even though quite different personal norms of response. Figure 5.10 provides quite a different picture. Here, the time period 11-25 is emphasized. The large peak in the wife's curve is due to the marriage of another of her children at that time. The husband's curve also shows somewhat higher stress at that time, but not nearly comparable to his wife's. By contrast, the daughter shows no concern with her sib's wedding. Consequently, the husband and wife dyad shows positive correlation for this time interval, while each parent is negatively correlated with the daughter.

The daughter's curve terminates at about this time. Subsequently, correlations for dyads involving her are necessarily zero, not because of independent stress response but because there are no data points for her. The husband-wife dyad continues to be positively correlated through the balance of the graph (.44). In sum, then, this family shows quite similar response to a major external stressor (the mountain), but quite disparate response to a stressor internal to the family (another child's wedding).

A quite different response pattern is demonstrated by the next family. In this instance, as demonstrated in Figure 5.11, there is virtually no overall correlation in any of the family dyads. That is, various points in

FIGURE 5.8. Family A: Stress Curves, Means, Standard Deviations and Dyadic Correlations

Correlations	
H-W	.63
H-G	.48
W-G	.62

	mean	st dev
Husb	3.44	2.83
Wife	3.09	2.26
Girl	1.81	1.14

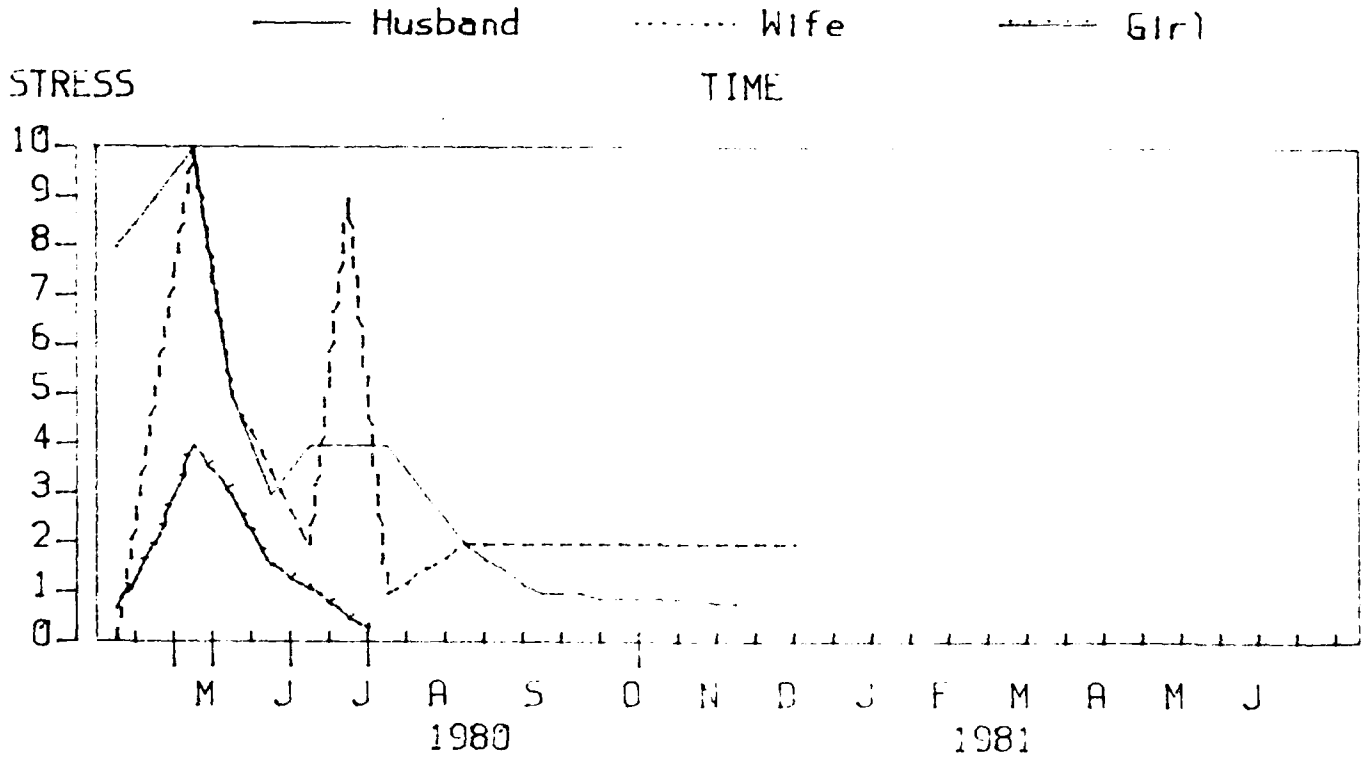


FIGURE 5.9. Family A: Data for Time Points 1 - 10

Correlations	
H-W	1.38
H-G	.75
W-G	1.35

	mean	st dev
Husb	6.80	2.52
Wife	4.82	2.74
Girl	2.27	1.02

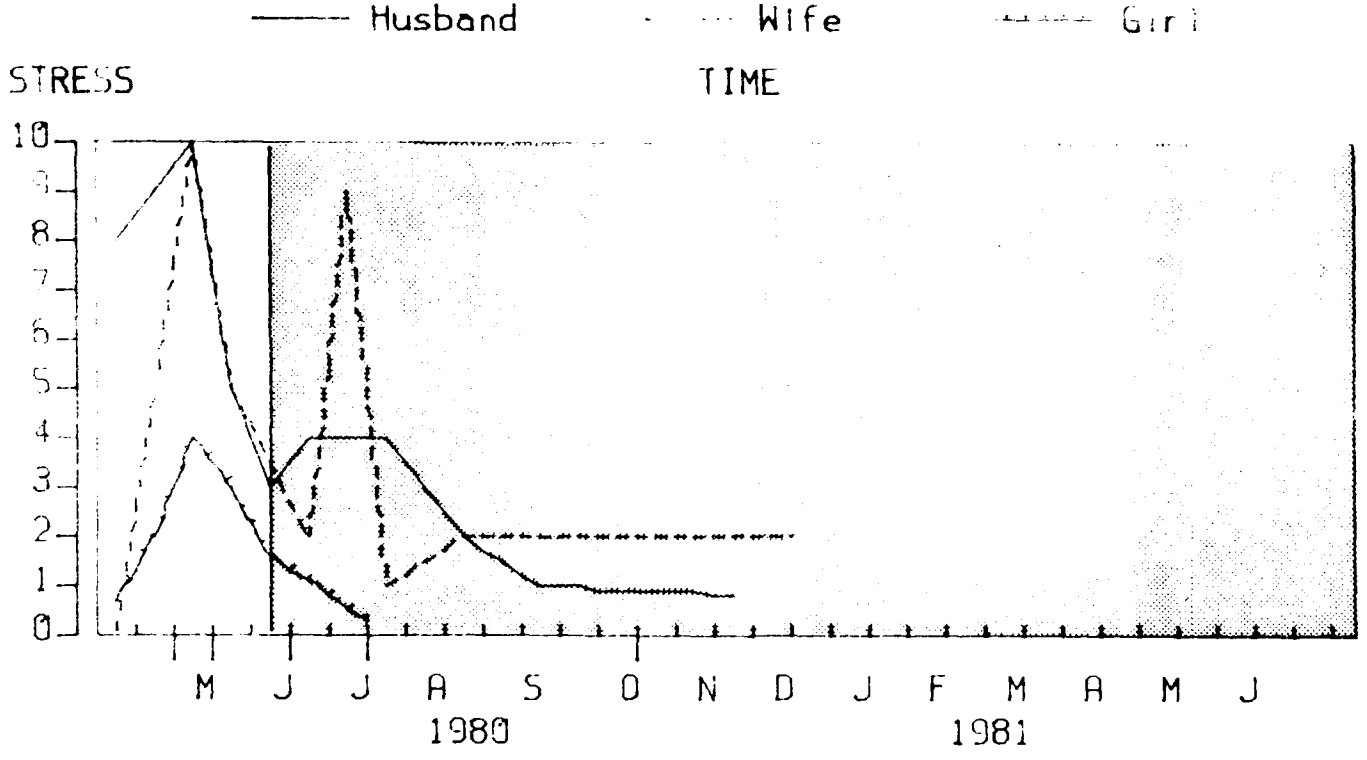
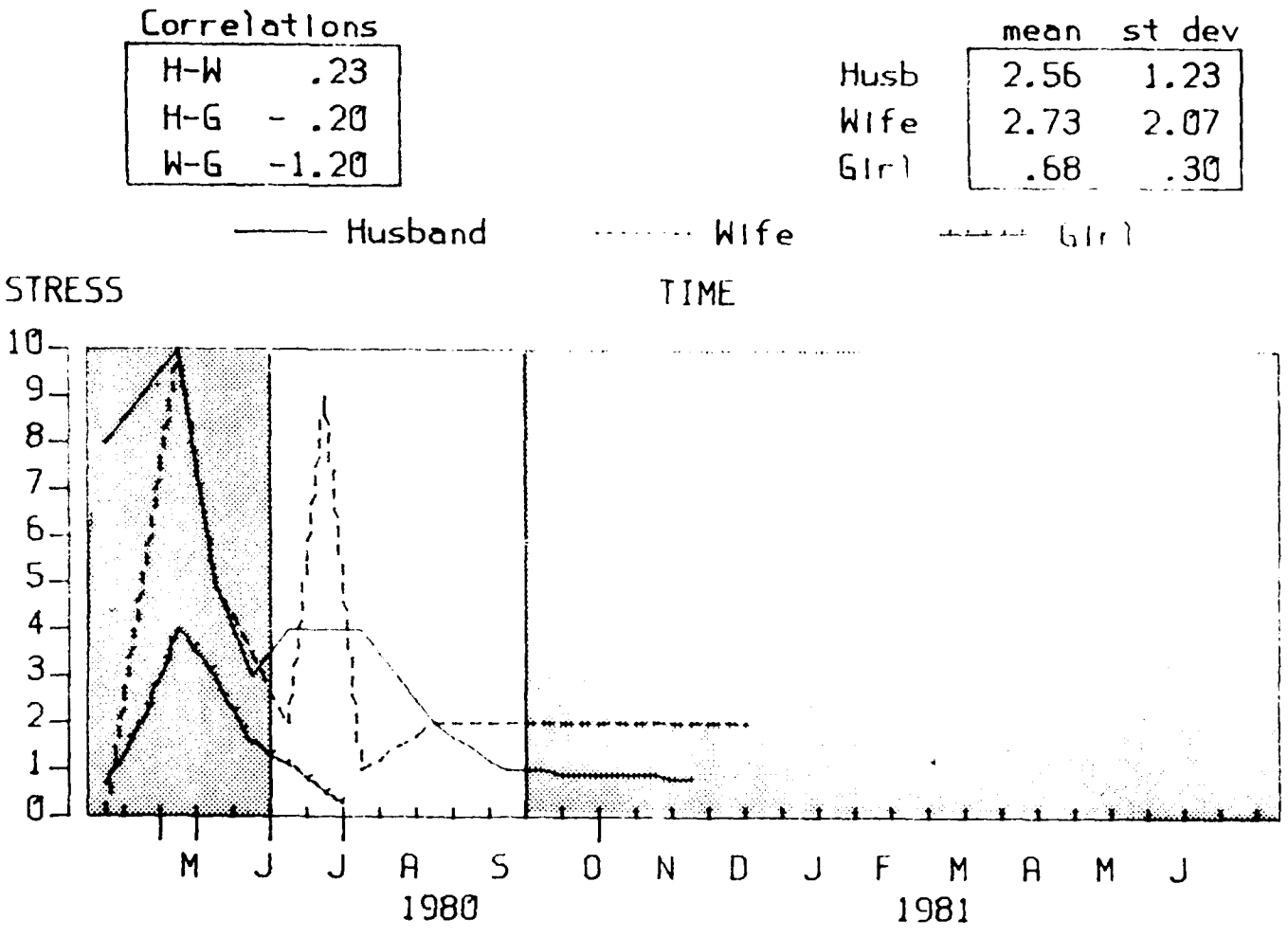


FIGURE 5.10. Family A: Data for Time Points 11 - 25



which members of a given dyad are positively correlated are offset by other points at which the same dyad will show negative relationship. A brief examination of some of the reasons for these changes in dyadic correlation follows.

The first time period (points 1-10) is emphasized in Figure 5.12. Here, the husband responded to the May 18 eruption only moderately and in somewhat delayed fashion. In contrast, both the wife and the son show very strong response to that initial eruption. The result is a high wife-boy correlation with moderate to low correlations involving the husband.

Turning to the next time interval (points 11-25), we find the husband quite strongly negatively correlated with both wife and boy. The pattern is highlighted in Figure 5.13. The wife and boy, on the other hand, show a moderate positive correlation. In fact, only the husband remained at home at this time while the rest of the family was out of the country. While they were away, a family friend living where they were visiting was killed. Consequently, their stress curves show response to that event, while it did not have comparable impact on the husband. That pattern of negative correlations for dyads involving the husband continues on through the rest of the first interview stress graph (points 26-39).

After that time, when the family has returned home, dyadic correlations again shift. Thus, for the time period 40-55, husband and wife curves are correlated .54, husband and boy .26, and wife and boy -.61. Subsequently, the husband-wife correlation reduces to .21, the husband-boy correlation becomes slightly negative (-.13), and the wife-boy correlation virtually disappears (.06). This family, then, shows considerable variation over time in the dyadic patterns. It will be remembered, however, that such shifts are relatively uncommon. In fact, most dyads remain quite stable and not highly correlated after the effect of the May 18 eruption has worn off.

FIGURE 5.11. Family B: Stress Curves, Means, Standard Deviations and Dyadic Correlations

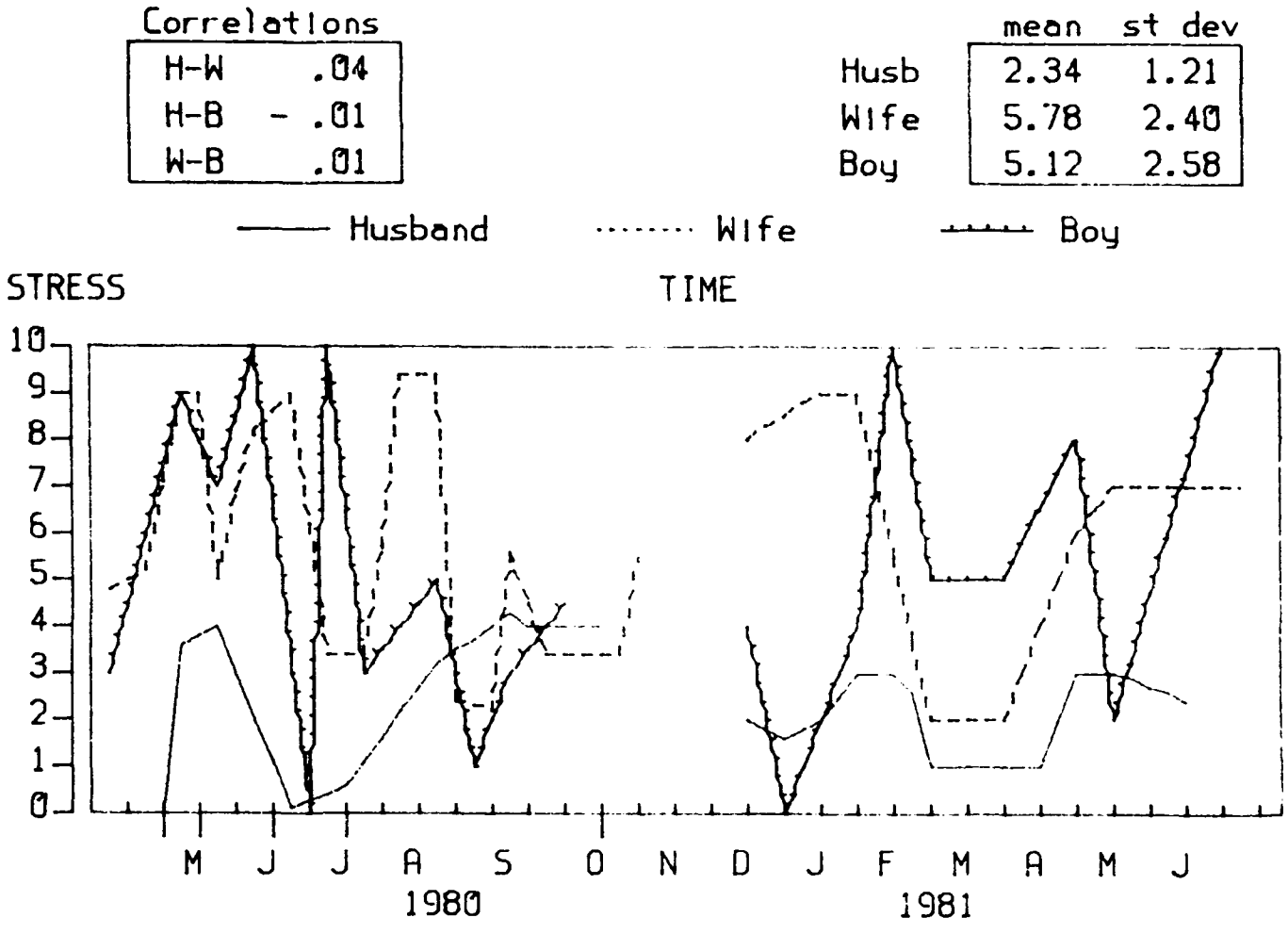


FIGURE 5.12. Family B: Data for Time Points 1 - 10

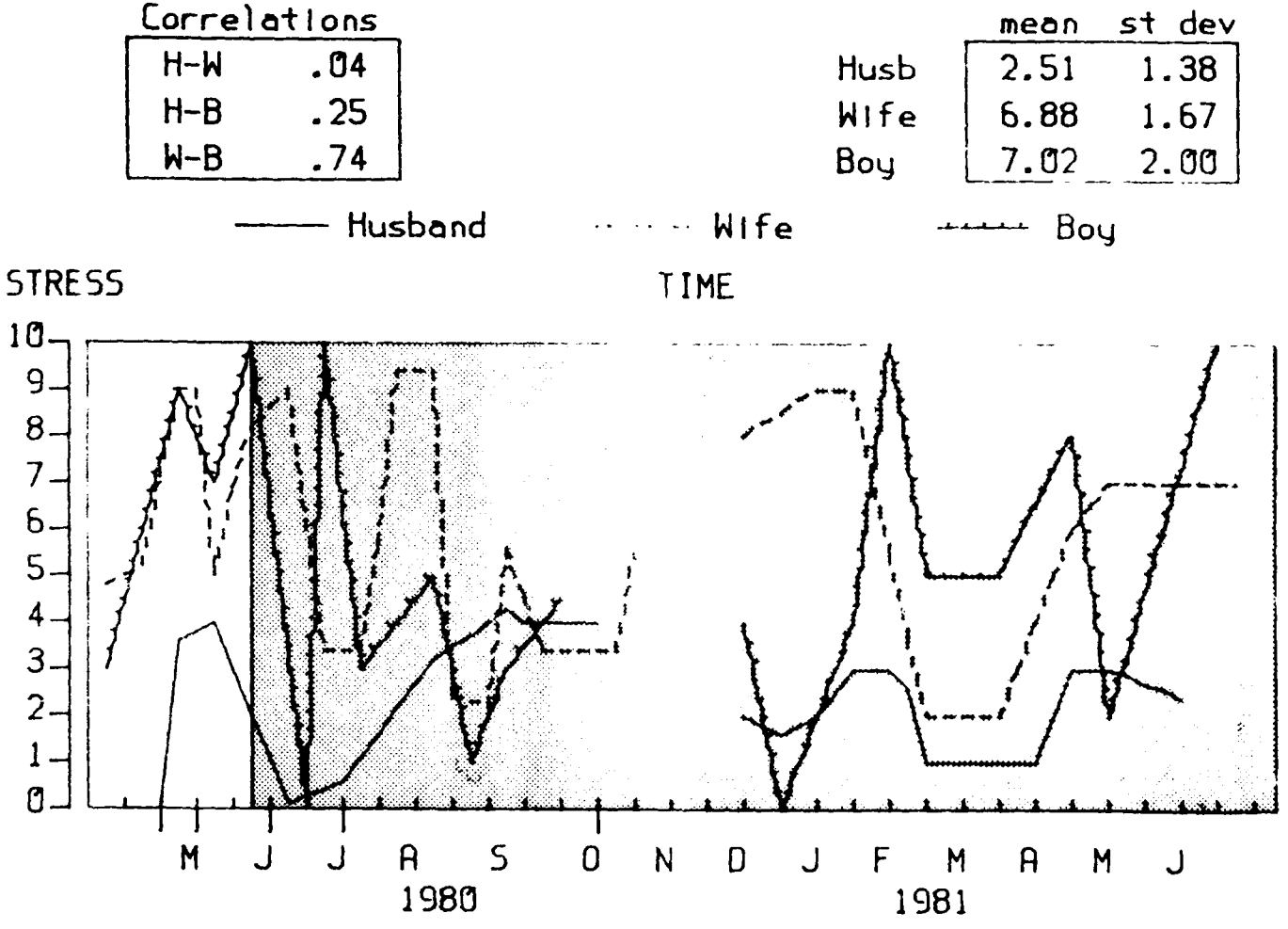
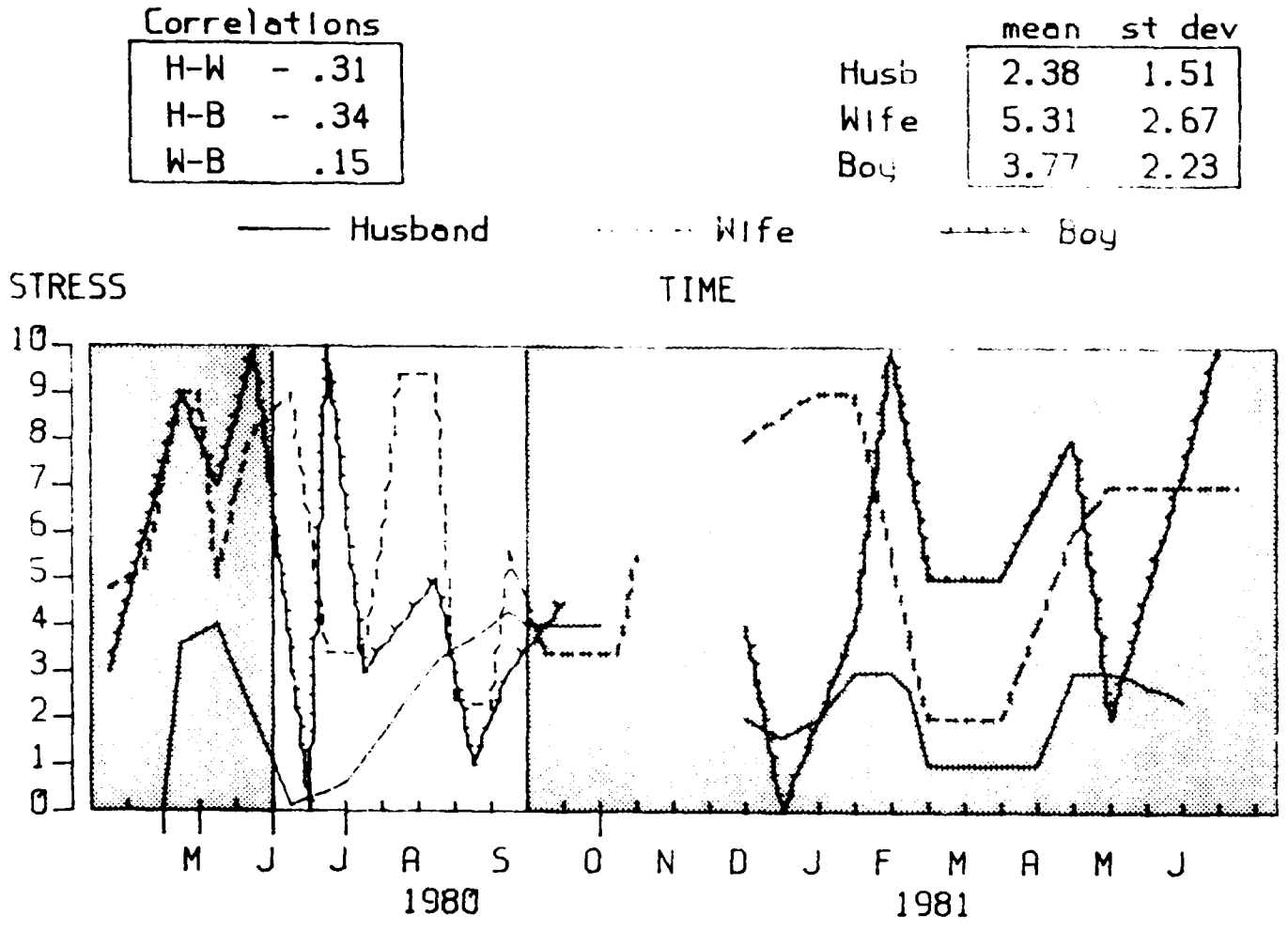


FIGURE 5.13. Family B: Data for Time Points 11 - 25



SUMMARY

It is evident from the data presented that the stress graph technique has a great deal of promise. First of all, it does provide the opportunity to chart over-time effects of stressors rather than assess stress only at one point in time. It allows for the interpretation of multiple stressors as well as common stressors. Second, it demonstrates the extent to which members of the same family respond similarly or differently to the events which impinge on that family.

Nearly all stress graphs show the effects of the May 18 eruption. There are a few exceptions, people who did not seem in any way disturbed by the volcano. In general, the effects of other stressors are scattered over time such that mean curves show only the May 18 eruption and the subsequent threat of flood in the Longview-Kelso area. Evidence regarding the standard deviations of the stress graphs indicates that variability of the graph across individual respondents is quite constant over time, even though the mean graphs for different sets of people show predictable differences. In particular, residents of Longview-Kelso show higher mean stress levels than do the residents of the other sites, both at the May 18 eruption and in the late fall and early winter when massive floods are threatening.

Evidence from the dyadic correlations indicates that the one source of highly similar response to stress is the volcano. Other events produced temporary similarity, but overall patterns show virtually no correlation. A simple family-type score summarizing the dyadic patterns shows greater similarity between time points 1-10 to time points 11-25, and less than random correspondence between that time. A great deal has been learned from these graphs which is not available from other procedures. It remains to be seen in subsequent analyses whether the stress graph data relate consistently to other [illegible] obtained

Chapter Six

THE EXPERIMENTS

RATIONALE AND METHODS

As indicated previously, two complementary procedures were to be used to study the families selected for in-depth analysis. First, each member was interviewed in detail, as reported in the previous two chapters. In addition, each family participated in a computerized game simulation experiment dealing with response to Mt. St. Helens. The argument for a simulation experiment component of the study is to enable direct observation of the over-time response of families to an environmental stressor. We do not argue that the simulation response is identical with what will happen if the mountain continues its threatening activity. We do argue that the response to stress individually and as a family should be well mirrored in the experiment. That is, there should be a correspondence between experimental response and real world response which will aid our understanding of how the volcano has affected the people living in its shadow. An experiment alone cannot replace an interview, which covers a much wider set of variables. On the other hand, an interview cannot obtain data on the actual decisions people make when confronted with problems or on the nature of family decisions when the entire family can be affected by the problem. A complete picture is obtained by asking and then observing. The experiments form a critical link in the chain of understanding family response to environmental stress.

It is impossible to convey the power and realism that a well constructed simulation can provide as a stimulus for family deliberation and decision making. Prior to the Mt. St. Helens project, we have conducted three years of such simulation experiments in a project dealing with community and family response to warnings of natural hazards. Our results corroborate with great

statistical confidence a number of hypotheses about how people respond to environmental threat. In addition, subjects clearly become involved in such experiments, treat them seriously, and report enjoyment in the experience when the sessions are over.

According to the original project plan, families would be interviewed in their homes, then taken to a mobile laboratory; that is, a motor home equipped with a microcomputer network on which the game simulation was to be conducted. For logistical reasons, the motor home was to be kept at Washington State University (subcontractor for field work for the project) at Pullman, then driven to Yakima or Longview for a number of days at a time to conduct interviews and experiments. The distance from Pullman to the other two sites is considerable, and highways contained not only the usual dirt and dust, but an extensive amount of volcanic ash due to the series of eruptions prior to the beginning of field work.

Unfortunately, some of the ash and dust apparently got into the computers regardless of how careful the staff was, causing malfunctions during early attempts at conducting the experiments. In addition, the power source in the motor home apparently was not well rectified, such that what would normally be minor power fluctuations became disabling fluctuations from the standpoint of the microcomputers. After a series of mostly abortive efforts to deal with these problems, the project changed strategy. Interviews were conducted in homes as originally scheduled, then families were taken to a local motel where the computers had been set up in a room designated as the field laboratory for that site. This procedure, while somewhat less convenient for the families, solved mechanical problems satisfactorily.

The equipment used in the experiments was three Terak microcomputers plus some networking hardware. Most programming problems had been solved for a Terak system in the Hazards project, and extensive software from that project was available for adapting to the needs of the Mt. St. Helens study. The Terak computers consist of a processing unit containing an eight inch floppy disk, a CRT (cathode ray tube), and a keyboard. The entire system is comparable in size to an office typewriter. The Terak CRT's have excellent graphic capability, so that maps as well as word messages can be generated.

During the experiment, individual members of the family were seated at separate computer keyboards, each with its own CRT for receiving written messages and maps from the computer. Although each terminal constitutes, in fact, a separate microcomputer, they were connected in a network so that activities on any computer could be affected by or could affect those on the other computers.

The simulation experiment contained two aspects. First, individuals played a business management game which was designed to be both a stimulating and a demanding experience. As business manager, each subject made decisions about hiring, firing, buying supplies, and selling products for profit. The computer generated extensive records, including bank balances, loans if necessary, updates on numbers of employees, levels of supplies, products on hand, warnings from foremen about management problems, and so forth. The game, which had been designed for the Hazards project, was sufficiently complex that it required considerable effort to make a sizeable profit. Most people did succeed in making a profit, but in the process became very caught up in the challenge of the game.

The second aspect of the experiment was a compressed time simulation of continuing volcanic activity that posed increasing threat and economic hardship for the areas around the mountain. A series of 14 messages, distributed over approximately 90 minutes of experimental time, interrupted the business activities to inform family members of events relevant to the volcano. Some messages reported minor situation, such as build up of the lava dome, while other messages reported extreme occurrences such as a major eruption. Table 6.1 contains the 14 messages as they appeared on the CRT's. Of course, they appeared one at a time, with three to four minute intervals between messages during which time the family members continued to operate their business. If a message announced an eruption of the volcano, the computer then displayed on the CRT a map of the state of Washington, showing the site where the family lived plus other major cities in the state, an indication of the location of Mt. St. Helens, and a gradual spread across the map of a representation of the ash cloud and subsequent fallout. Figures 6.1 through 6.4 show the eruptions as they appeared on the CRT's. Note that the three sites (Pullman, Yakima, Longview-Kelso) are differentially affected by the events reported in the bulletins and shown in the eruption maps.

After each of the 14 messages, the family member-business manager was allowed to choose whether to continue operation of the business in routine manner or to close it down to protect it against the effects of the mountain. Of course, closing down the business lost the opportunity to continue making money, but protected supplies and personnel from damage due to the volcano. A similar simulation was used in the Hazards experiments, with a tornado hazard rather than a volcano. The tornado, however, followed a fairly consistent path to the vicinity of the site of the subject's business. Therefore, it generated a sense of deadline for decision as it came closer to the business location.

TABLE 6.1. Messages Reporting Volcanic Activity

Message Number	
1	Geologists report that the dome in the crater of Mt. St. Helens has suddenly begun growing at the rate of about 2 feet per day. This is the first activity of the volcano in many weeks.
2	Increased tremors in the range of 2.0 on the Richter Scale have been reported at Mt. St. Helens. There is increased bulging of the dome inside the crater according to Forest Service observers.
3	Officials have ordered all persons to evacuate the Red Zone of Mt. St. Helens due to increased frequency of tremors and the opening of a new steam vent. An eruption alert has been issued by the Federal Emergency Management Agency.
4	Mt. St. Helens erupted at 10:48 a.m. today, sending a plume of ash to approximately 47000 feet. Light winds from the southeast are expected to carry the ash in a wedge pattern between Olympia and Hoquiam. Heavy ash fallout has caused closing of Highway 12 over White Pass.
5	Washington State is expecting a large budget deficit due to the costs of emergency preparedness and extensive clean-ups caused by the eruptions of Mt. St. Helens over the last nine months. The governor is urging special tax increases and asking for additional Federal assistance.
6	Physicians in many communities in Washington State report increasing evidence of health problems because of the Mt. St. Helens eruptions. Some experts fear that there may be long-term consequences for many residents.
7	An earthquake of magnitude 3.0 on the Richter Scale has caused avalanches and mudslides to the north of Mt. St. Helens, threatening flooding along the Cowlitz River. Mossy Rock Dam appears undamaged, but the Army Corps on Engineers is still examining the Mayfield Dam. Any further slides could cause serious flooding along the Cowlitz River.
8	Highway 12 from Salkum on the west to Randle on the east is still closed to the general public as the result of earlier avalanches and mudslides.
9	Geologists report an increase in seismic activity on Mt. St. Helens. It is believed that the mountain may be entering a new active phase.
	At 3:25 p.m. Mt. St. Helens had its most serious eruption since May 18, 1980. An ash plume rising approximately 50,000 feet is being carried eastward by strong upper air currents from the west. Traffic is at a standstill in Yakima, and considerable fallout is expected through eastern Washington, Idaho, and into western Montana.
11	Geologists have noted a change in the lava in the crater of Mt. St. Helens These changes have not been observed previously, and experts are unable to predict how the mountain will act in the future.
12	A series of sharp earthquakes began this morning at Mt. St. Helens, followed by lava-flows to the south, reaching four miles down the slope.
13	Mt. St. [illegible] erupted four times in the last six hours. There has been extremely heavy pumice fallout near the mountain. Ash is drifting to the southeast. A volcano alert remains in effect. Due to the conditions on the mountain, we have not been able to contact officials for further information.
14	There has been [illegible] enormous eruption of Mt. St. Helens. The blast was heard as far east as Pullman and Spokane. Lava and mud flows have caused massive flooding on Cowlitz, Lewis, and Toutle Rivers. A huge ash cloud has covered virtually all of eastern Washington.

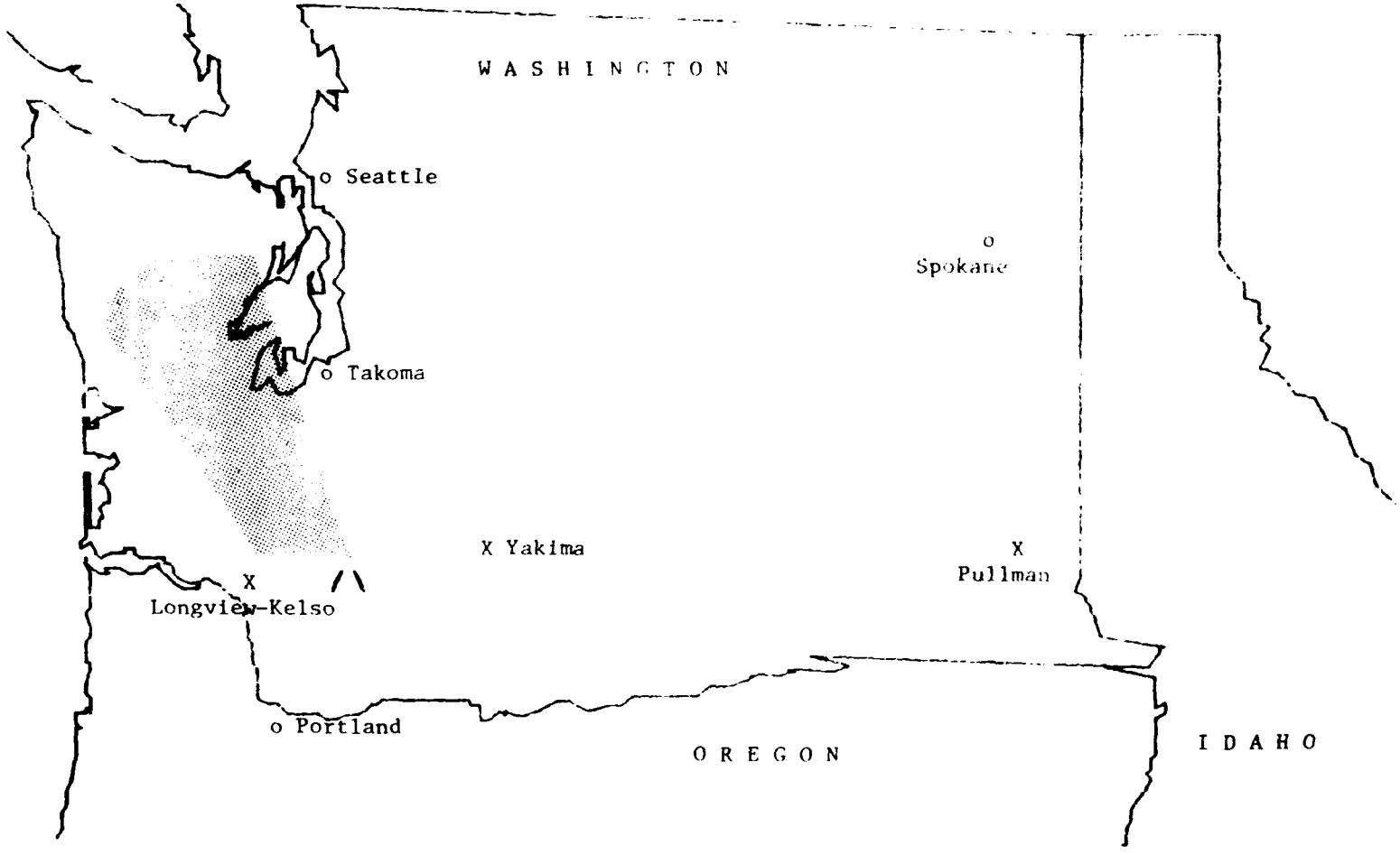


FIGURE 6.1. Map Accompanying Message 4.

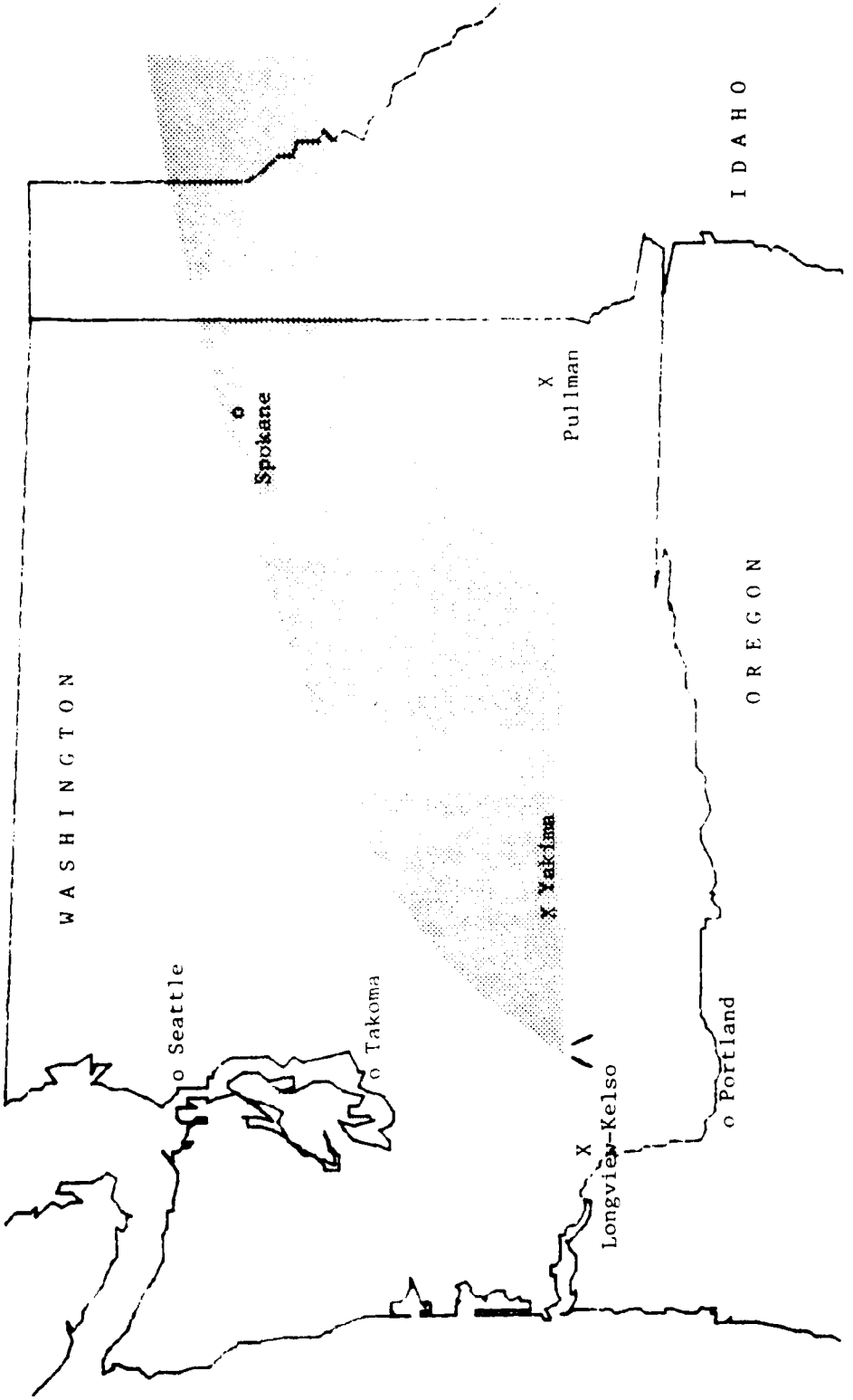
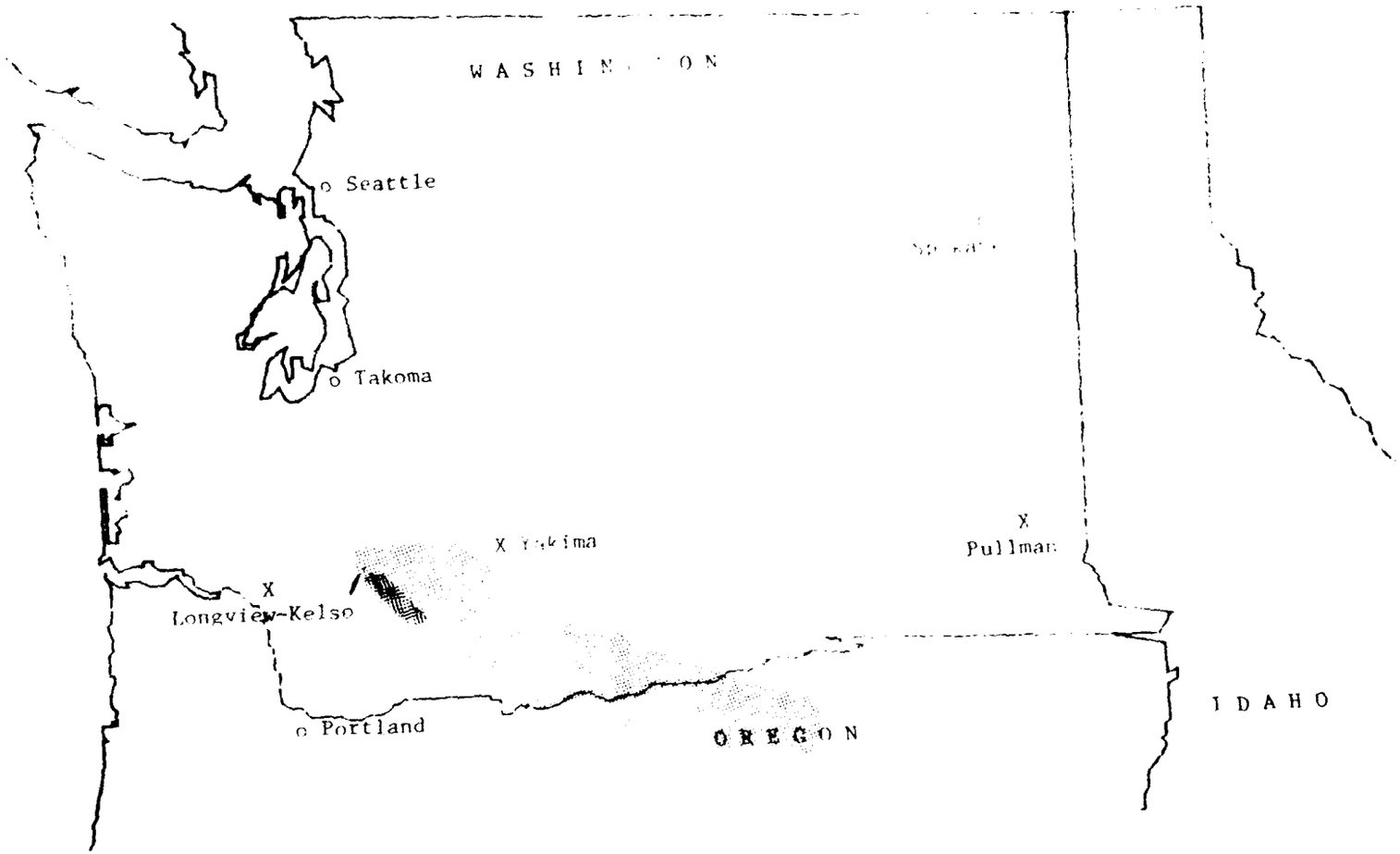


FIGURE 6.2. Map Accompanying Message 10



Map Accompanying Message 13

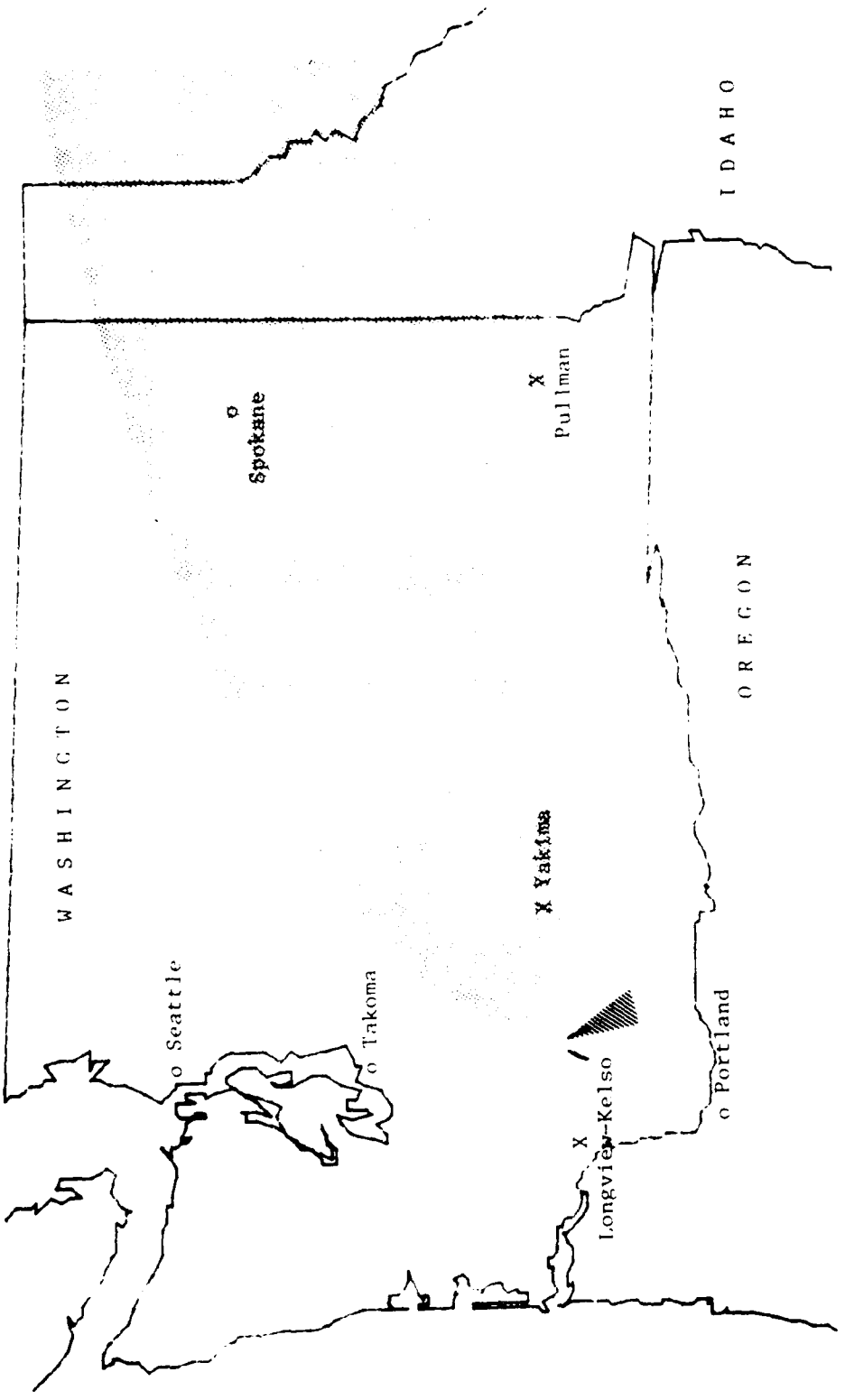


FIGURE 6.4. Map Accompanying Message 14

In contrast, a volcano shows various signs which could be interpreted as increased threat versus abatement of threat. There is no more-or-less linear approach to a deadline for action, but rather a continuing problem which seems more or less severe at any time. In contrast to the accelerating [illegible] plant as the tornado approached, which was [illegible] experiments, we anticipate a somewhat more chaotic response to the [illegible] ements about the volcano in these experiments.

After [illegible]ssages 4, 7, 10, and 14, two other types of decision were required. [illegible]vidual members were asked to record on the computer whether they [illegible] move from their current location or to continue operation where they were. If they indicated a preference to move, they were asked where and given an estimate of how much it would cost them to move their business that far, how many employees would come with them versus quit, and what [illegible] their family to move that far. The costs were approximately realistic and also compatible with the overall income generated within the experiment.

After these individual preferences were recorded in the computers, the computer then informed each of the family members that the family as a group had to discuss whether the family would move or would stay at its present location. The computers would not continue the game until a family decision had been recorded by the experimenter and the system restarted. Family members then turned toward each other, away from their computers, and discussed, to whatever extent they wished, whether they would move or stay. As will be evident, [illegible] chose to move, although the majority chose to stay where they were.

If a family [illegible] not to move, they returned to their routine, individual activities on the computer until the next required discussion. Of course they would [illegible] at the same risk from the mountain depending upon

where they lived. If they chose to move, the distance and direction away from the volcano were used to alter two aspects of the game. First, costs were assessed as indicated previously, and their individual and company bank balances were appropriately reduced. Secondly, their risk from future volcanic activity was altered to take account of their new location. That risk was functional in the game to the extent that ash or lava struck the area where their business operated. Various degrees of lost productivity were assessed under such circumstances, which required some time to overcome and return to normal productivity. In sum, if a family moved it would experience certain losses, although different members of the family would have different levels of loss due to the individual characteristics of their businesses. If the family stayed, it would continue to experience the same threats from the volcano while carrying on business as usual.

A decision to move did not terminate the game. After adjusting for the distance moved, the experiment continued with the new hypothetical location shown on the map if it was within Washington State, and the family was allowed to remain at its new location at subsequent decisions or decide to relocate again if they so chose. Although relocation a second time was possible, and return to original location was also possible, no family chose to move twice.

One advantage of the computer system was that all decision data were automatically recorded in sequence and by time in the computers. In addition, before the experimental sessions began, the experimenter entered a variety of data in the computer that had to do with the demographic characteristics of the family member who was at each terminal as well as case identification information. Thus, a complete record of each person's individual information and performance was obtained on disk as the game proceeded. These data could be analyzed within the Terak system or transferred to the central computer system for analysis with the rest of the data file.

There are four kinds of data, then, to be examined in this chapter. First, we will look at the individual decisions to close shop or continue operating as usual. That gives some indication of individual predilections and responses to the threats posed by the volcano. Secondly, individual preferences for moving will be examined, followed by the family decisions whether or not to move. Finally, some transcripts from the family discussions will be presented for illustration rather than for formal analysis. Each family was told that all discussions would be audiotaped, and those tapes were subsequently transcribed. Although some families provided very little discussion, some of the debate and commentary was particularly informative about response to the game, response to Mt. St. Helens, and the nature of family interaction.

BUSINESS DECISIONS

Table 6.2 contains the number of individuals who chose to shut down their businesses. Data are presented for each of the 14 messages, and each of the three sites. Although 20 three-person families were studied in each site, providing 60 individuals per site, not all family and individual experimental data were obtained as planned. One family in Pullman, one in Yakima, and one in Longview-Kelso were lost due to mechanical difficulties involving the tape records either during or after the experiment. In addition, two individuals from Pullman and one from Yakima had records lost for similar reasons. Consequently, the number of individuals for which data are recorded are 55, 56, and 54 for the three sites respectively.

There are two important aspects of the data in Table 6.2. As noted before, the earlier [illegible] contained a more-or-less linear [illegible] of action, such that the proportion of subjects who

TABLE 6.2. Decisions to Shut Down Business, by Site and Message

Message	Pullman n = 55*	Yakima n = 56	Longview-Kelso n = 54	Total n = 165
1	0 (0)	3 (5.4)	0 (0)	3 (1.8)
2	2 (3.6)	3 (5.4)	0 (0)	5 (3.0)
3	1 (1.8)	6 (10.7)	2 (3.7)	9 (5.4)
4	0 (0)	6 (10.7)	1 (1.9)	7 (4.2)
Family Decision #1				
5	0 (0)	3 (5.4)	0 (0)	3 (1.8)
6	4 (7.3)	6 (10.7)	4 (7.4)	14 (21.6)
7	1 (1.8)	3 (5.4)	2 (3.7)	6 (3.5)
Family Decision #2				
8	1 (1.8)	2 (3.6)	0 (0)	3 (1.8)
9	2 (3.6)	2 (3.6)	0 (0)	4 (2.4)
10	8 (14.5)	20 (35.7)	0 (0)	28 (17.0)
Family Decision #3				
11	2 (3.6)	4 (7.1)	0 (0)	6 (3.5)
12	0 (0)	3 (5.4)	3 (5.6)	6 (3.5)
13	1 (1.8)	6 (10.7)	1 (1.9)	8 (4.9)
14	32 (58.2)	22 (39.3)	11 (20.4)	65 (39.4)
Family Decision #4				

*Twenty families, or 60 persons per site, were scheduled. Mechanical problems reduced useable, completed sessions to 19, 19 and 18 families for the three sites. Additional problems reduced Pullman individual member records by 2, and Yakima by 1.

Percentages are shown in parentheses.

responded (took protective action) increased in an accelerating curve as the deadline approached. However, the volcano presents a different kind of scenario. There is a continuing build up and release rather than a single termination of the scenario. Therefore, the number of individuals who chose to take defensive action fluctuates considerably through the 14 messages.

Note in particular that certain messages generated relatively high rates of response. That is, message number 6 generated 21.6 percent response across all subjects and sites. Message number 10 generated 17 percent response, and message number 14 generated 39.4 percent response. That is,

approximately two out of five subjects chose to close their company operation after message 14.

It is interesting to note that there is considerable difference by site in response to these key messages. In particular, Yakima shows the strongest response to Message 10, while Pullman shows the strongest response to Message 14. A review of the messages and the appropriate maps indicates a differential relevance of these messages for those two sites. It is also interesting that the Longview-Kelso area shows the lowest response rate in this portion of the experiment even though that site is under greatest threat from the mountain. Of course, the simulation involved primarily ash and fallout threat, with serious flood being a threat only at the end of the experiment. Since most of the ash drift was east rather than west, the Longview-Kelso area was less threatened in the simulation than those more distant.

There is a [illegible] important aspect of the individual decisions. Although some build up seems to occur at Message 4 (six cases in Yakima and one in Longview-Kelso) the frequencies drop again at Message 5. Similarly, there are six decisions to shut down at Message 7, but the number reduces to three at Message 8. Again, there are 28 decisions to shut down at Message 10, but only six at Message 11. There are two possible explanations for this phenomenon. First, there is some easing of the apparent threat of the mountain at the points cited. More importantly, however, a family decision discussion has intervened between the times noted. As will be evident from Table 6.3, as well as from the transcripts, families often talked individual members out of a desire to shut down and leave, in the interest of the family as a unit staying. It is apparent from Table 6.2 that various individuals were convinced to "stick with it" after discussions with their families.

Information on individual preferences for moving and on family decisions about moving is contained in Table 6.3. The first part of the table pertains to the individual preferences, and the second part to the family decisions. Note first that location considerably affects preference to move. The Pullman and Longview-Kelso family members seemed to build up over time, or at least have their largest frequency at the fourth opportunity for such a decision. In contrast, the Yakima members show the highest frequency of preference to move at the first opportunity for such a decision, with reduced frequency of such preference after that time. As can be seen from Part B of Table 6.3, one Yakima family did choose to move at the first opportunity. That should have reduced the number of family members wishing to move in subsequent rounds, hence part of the change in Part A of the table may be attributed to that move. At the most, however, that could affect three individuals.

TABLE 6.3. Individual Preferences and Family Decisions to Move, by Site and Decision

A. Individual Preferences for Moving

Decision	Pullman n = 55	Yakima n = 56	Longview-Kelso n = 54	Total n = 165
1	1 (1.8)	10 (17.9)	5 (9.3)	16 (9.7)
2	2 (3.6)	2 (3.6)	4 (7.4)	8 (4.8)
3	5 (9.1)	4 (7.1)	2 (3.7)	11 (6.7)
4	12 (21.8)	1 (1.8)	10 (18.5)	23 (13.9)

B. Family Decisions

Decision	Pullman n = 19	Yakima n = 19	Longview-Kelso n = 18	Total n = 56
1	0 (0)	1 (5.3)	0 (0)	1 (1.8)
2	0 (0)	0 (0)	0 (0)	0 (0)
3	0 (0)	0 (0)	1 (5.6)	1 (1.8)
4	4 (21.1)	0 (0)	5 (27.8)	9 (16.1)
Totals	4 (21.1)	1 (5.3)	6 (33.3)	11 (19.7)

See Table 6.1 for explanation of sample sizes.

Percentages are shown in parentheses.

As noted previously, Yakima family members respond somewhat differently from the rest of the families studied in a number of respects. It is quite possible that a sort of determined self reliance would result in a gradual reduction in the willingness to be influenced by the simulated threat of the mountain in the game simulation context. We do not have sufficient basis for determining whether differences in regional ethic could be behind the pattern of data observed in the experiments. There is the possibility, though, that such regional variation will considerably influence the manner in which individuals and families will respond to such an external threat.

The number of families who actually chose to move during the simulation is shown in the second portion of the table. Obviously, very few families moved except at the last opportunity to do so. As noted, one Yakima family moved at the first opportunity, and also one Longview-Kelso family moved at the third opportunity. Then, nine more families moved during the fourth and final family decision opportunity.

Because moves are cumulative, in that families who moved previously are not families who moved subsequently, a total of 11 families out of 56 chose to relocate due to the simulated threat of the mountain. This relocation is despite both individual and family costs imposed during the game. Eleven of 56 cases constitutes approximately 20 percent of the experimental families who chose to relocate. That figure is certainly compatible with the number of families who evacuate or move more permanently in the threat of such disasters as major hurricanes and tornados.

It should be noted that the information contained in the last messages was really quite severe. That is, the mountain was posing a really serious threat to the entire area. Also, it should be recognized that it is easier to move in a game simulation than it is in reality, although transcriptions

of the discussions suggest that most families tried to play the game as realistically as possible. Apparently, even under very severe threat, relatively few families will decide to move away from the source of the threat.

These data corroborate both the interview data and the telephone survey data, which indicate a very strong resistance to the idea of moving just because a volcano is threatening. In fact, these results are parallel to reactions to other major hazards. People consider a move as a last resort for dealing with the problem, and some will not consider that resort under any circumstances. The celebrated case of Harry Truman, who lived on Mt. St. Helens and was eventually killed in the eruption, presents an extreme but not a unique example.

It is instructive to refer back to the first part of Table 6.3 when reviewing the second (family decision) part. Although a number of individuals wished to move at various times, almost no families moved until the last opportunity. Thus, for example, ten Yakima family members wished to move at the first option, whereas only three (one family) actually moved. Five Longview-Kelso individuals also wished to move at that time, but none did. In fact, family discussions indicate time after time that at least one member of the family had strong reasons for wishing to remain. Often that had to do with success in the business game, but other reasons were cited as well. In such circumstances it was more often than not the case that the family would choose in favor of the person adamant about staying.

It should be mentioned that the game rules required that the entire family move as a unit or stay as a unit. That is not always true for response to actual hazards. In fact, there is considerable evidence from the disaster research literature that family members will be sent out of the threatened

area while the family head stays to carry on economic activities as well as attempts to protect the household. In fact, one husband in our experiments specifically stated that if the rules allowed, he would stay and send his family to safety. For this particular experiment, the whole family chose to stay.

This deference to a family member preferring to stay raises interesting problems for getting people to evacuate when a serious threat is present. It is in some sense easier to undertake no action, especially if someone is urging not moving, than it is to move. This entire aspect of family decision making deserves greater study in the future.

COMPARING EXPERIMENTAL AND CONTROL GROUPS

It will be remembered that 10 families in Minneapolis were studied as a comparison group not subject to the threat of Mt. St. Helens. Not all the same questions were asked in the interviews because some would have been ludicrous, but exactly the same experimental procedures were used. Of course, some explanation of the geography of Washington State was needed for Minnesotans, who typically are not familiar with the location of the volcano and the sites around it. All Minnesota families were told that they were, for the sake of the experiment, living in the Longview-Kelso area.

Table 6.4 contains a comparison of the experimental subjects, combined across sites, with the control subjects from Minneapolis. Almost all percentages are quite small, so there are few large discrepancies between how the two sets of individuals responded to the game simulation. In fact, the Minneapolis sample behaviors appear quite parallel to the Longview-Kelso sample, their closest counterparts in the game-simulation. There are some interesting differences in Table 6.4, however.

TABLE 6.4. Experimental (Washington State) versus Control (Minneapolis) Sites

A. Decisions to Shut Down Business

Message	Experimental (n = 165)	Control (n = 30)
1	3 (1.8)	0 (0)
2	5 (3.0)	4 (13.3)
3	9 (5.4)	5 (16.7)
4	7 (4.2)	5 (16.7)
5	3 (1.8)	0 (0)
6	14 (21.6)	1 (3.3)
7	6 (3.5)	4 (13.3)
8	3 (1.8)	1 (3.3)
9	4 (2.4)	0 (0)
10	28 (17.0)	2 (6.7)
11	6 (3.5)	0 (0)
12	6 (3.5)	3 (10.0)
13	8 (4.9)	3 (10.0)
14	65 (39.4)	1 (3.3)

B. Individual Preference

Decision	Experimental	Control
1	16 (9.7)	5 (16.7)
2	8 (4.8)	1 (3.3)
3	11 (6.7)	2 (6.7)
4	23 (13.9)	6 (20.0)

C. Cumulative Family Decisions

Decision	Experimental (n = 56)	Control (n = 10)
1	1 (1.8)	1 (10.0)
2	1 (1.8)	1 (10.0)
3	2 (3.6)	1 (10.0)
4	11 (19.7)	2 (20.0)

Percentages are shown in parentheses.

Minneapolis individuals apparently acted sooner than did those familiar with the volcano and the area. Although the same individuals may well be represented in these percentages, if the percentage choosing to shut down business during the first four messages is compared between the experimentals and the controls, a very large difference appears. That is, the sum of those four percentages is 14.4 percent for the experimental group versus 46.7 percent for the control group. It is a common finding that people unfamiliar with a threat will react to it sooner than people who are "old hands."

The next interesting aspect is that the Minneapolis family members do not respond particularly to Message 6, Message 10, and especially Message 14. Why? The probable explanation is that people in Minneapolis simply do not have the basis for understanding the seriousness of the threat in any real, personal sense. In contrast, people in Washington State know first hand the kind of devastation that the mountain can cause. As seen in earlier chapters, they have considerable awareness of many drastic consequences of previous eruptions. Consequently, they are reacting in the simulation experiment much more readily than are those in the control group.

The final message shows a truly remakrable difference in response rate, as if the control group had by this time "tuned out" the importance of the volcano and simply concentrated on running a successful business. From the discussions, however, it was evident that the Minnesotans were unaware that Longview-Kelso is on the Cowlitz River. For example, "Are we near the Cowlitz?" "I don't think so, or they would have told us." Comments were made about ash and lava, such as, "It's going the other way, we don't have to worry," despite considerable flood threat which actual Longview-Kelso residents readily recognized.

This finding should not suggest invalidation of the procedures, but rather that the use of game simulation experiments for studying such real world problems make sense only if the problems have a reality to the people being studied. Our earlier work with the Hazards project used a tornado scenario for studying Minneapolis people. That scenario was very real to the residents of an area frequently threatened by severe tornadoes. Probably, people living around Mt. St. Helens would have responded less strongly to that scenario than the Minneapolis people.

The second and third portions of Table 6.4 contain individual preference and family decision comparisons. Both of these aspects of the data show much greater similarity between experimental and control groups than was evident at the individual decision level. In fact, these data suggest less difficulty in transporting a game simulation outside its realistic arena than we had concluded from the first part of Table 6.4. Although that may be true, it is evident that some specific aspects of response are considerably altered as local realism is lost.

A few other pieces of information will help compare across sites. Because data were automatically recorded, it is possible to recover some information about how well people performed in the game. That is, we can determine how many cycles people played, where a cycle consists of one set of business decisions and their consequences. Also, it is possible to recover the business bank balance at the end of the experiment as well as the individual member's personal bank balance. The mean number of cycles completed, by site, were: Pullman, 135; Yakima, 93; Longview, 112; Minneapolis, 131. Obviously, Pullman and Minneapolis family members played the game somewhat more rapidly than did those in Yakima and Longview. More rapid play usually implies greater comfort with the nature of the business and a feeling of somewhat greater competence at running the business.

That interpretation is supported by both types of bank balance. Mean business bank balance, by site, was: Pullman $76,438; Yakima, $38,881; Longview, $52,731; and Minneapolis, $78,120. Similarly, mean personal bank balances were: Pullman, $23,222; Yakima $11,233; Longview, $14,895; and Minneapolis, $22,242.

It is obvious that people in Pullman and in Minneapolis did particularly well at the business, with those in Longview doing somewhat less well and those in Yakima doing least well. There may be many explanations of these differences, but the most probable is the sizeable difference in the families' occupational status across sites, which is typically accompanied by educational differences as well. In fact, mean family income (real income, not game income) for the three experimental sites shows the same ordinal progression.

If doing well at the game deterred individuals or families from moving, then Yakima should show more tendency to move than any of the other sites. We do know, from the decision discussion tapes, that some family members doing very well did deter the family from moving on a number of occasions. But Yakima families chose to move less often in the game simulation rather than more often. Here, again, is a distinct difference in mode of response which distinguishes Yakima from the other areas. Apparently there is a "tough it out" ethic in that area which far less often entertains the notion of leaving a problem, choosing instead to put up with it or solve it.

ILLUSTRATIONS FROM THE FAMILY DISCUSSIONS

We close this chapter with selections from the transcriptions of the family discussion tapes. Obviously, these are not chosen to be representative so much as they are chosen to be illustrative of certain kinds of considerations appearing in the family decisions. Also, they make clear how families responded to the game as well as to the mountain.

The first cases illustrate the problem that people from Minneapolis had in responding to the simulation. One person even called the mountain "Mt. Helenus" despite the extensive publicity it has received. Another had little understanding of the volcano, as evidenced from the following conversation.

Husband: Well, at this time...Well, we have to talk over about the fact that we gotta get out of here or not. I think the fact to me that that thing has only erupted once in 40, 50 years, I don't think we should...

Wife: pa[illegible]

Husband: ...panic and get out. I think we should wait for the...hope that we don't get killed in the thing and just clean up the mess when it's over and go back about our business.

Wife: (Unintelligible)

Teen: Right now there's been no...You'd think it would be a one-shot thing, such a dead volcano.

Another case underscores the unreality for some people not living in the vicinity of the mountain.

Wife: Now we shall talk.

Teen: Now we get to talk. Do you want to move?

Wife: (Sighs) You know, this is so unreal. Because we know we're not there.

Teen: I know. So?

Husband: Well even if I was there, I wouldn't move.

Teen: Even if I was, I wouldn't move.

Husband: We're supposed to assume that we're there.

Wife: Yeah, but that...reality's one thing, fantasy's another. This is fantasy. And I know I'm not there. So I can sit here and say, Hell, I'm not moving, I'm making money.

Teen: We're not moving either, but...

Husband: Well, yeah, I understand that. So let's press on.

Teen: Yes. If the lava or the ash starts coming, we can always move south.

By contrast, one Washington State family went into considerable detail in discussing how they could move their personal possessions if they went elsewhere. Of course, such a concern was not relevant to the simulation. Obviously the simulation proved to be very relevant to their own family concerns. That appears true also in the following case.

Teen: Well, I'm moving.

Wife: With or without us, huh?

Experimenter: Go ahead.

Husband: Ah, uh, oh, I don't know. You know, this is...it's still the health thing that bothers me. I haven't heard any other health bulletins, though.

Teen: What's your vote?...Oh, yeah?

Experimenter: Again, this is your individual vote, how you feel about it...

Teen: Mom, we're moving.

Wife: No, shh, you're supposed to be quiet now.

Teen: I have 52,000 bucks in the bank.

Wife: Ok.

Husband: What'd you decide?

Wife: I said no, but I'm willing to (unintelligible).

Husband: (Unintelligible) confirmation about the health hazard.

Teen: What about the health?

Husband: Well, they haven't said anything more about the health. The next bulletin may have the health, but I need to liquidate some stuff...Ok, You're the deciding vote.

Wife: Well, that's what you told me last time. I said I had voted no, but I said I'd vote to move if you wanted to, if you had any reasons...

Husband: Ok, we're not moving.

Teen: [illegible]

Husband: It isn't fair to go by the individual.

Wife: I just closed down...

Teen: Well, that's a good place to move then. We're moving.

Husband: Well, wait a minute...What was your response, a no? No to your move?

Wife: Yeah.

Husband: Well then, how come you're changing?

Wife: Well, because I was on the fence about it. I mean, I could go either way in the family disucssion. I was kind of on the fence about which way to go.

Teen: Well, if you've just closed down it's the perfect time to move.

Husband: Yeah, but how come you voted no, then?

Wife: Well, because I, I can just look at it either way...

Husband: Oh, that's no reason for voting no.

Teen: Well, that's past. No, we're moving out,..Right, Mom?

Wife: Well, I don't want to be the person to...

Teen: You should think about health hazards.

Husband: It didn't hit Pullman.

Wife: No, I know. But the question is how much more...

Husband: It may, but (husband and wife start talking at the same time).

Teen: Yeah, but you're just going to wait until it's too late. We're gonna get wiped out.

Wife: Ok, well, let's just wait a little longer and see if it settles down.

Teen: Ahh...

The next excerpt from a Longview-Kelso family indicates the way people familiar with the threat of Mt. St. Helens related the simulation to their reality.

Wife: Now what do you think?

Experimenter: Talk it over.

Husband: Well, I don't think there's any danger here. With all the work they're doin' up there on that river right now, I don't see why it wouldn't keep open. If it, they keep the river open and the water can get through to the Columbia, the Columbia's big enough to handle anything that comes in there. I'd say we're safe as long as anybody else down along here is and everybody else's businesses keep going so why shouldn't we?

You wanna quit?

Wife: No, I'm gonna stay.

Husband: You gonna stay or go?

Teen: I'm stayin'.

Husband: Ok.

Wife: There's no need to run from anything.

Husband: Yeah, ya leave the flood and go into an earthquake in California.

Wife: Or tornadoes.

Husband: Back in Missouri, you get a tornado.

(Somebody says something about, "go somewhere else and you get stabbed.")

Wife: Go to LA and you can do that.

(Following Discussion)

Husband: Seem like the, all the eruptions goes to the east. Wind always carries it to the east.

Wife: May the 18th we had it.

Husband: Yeah, but that was just, uh, I'd say that was part of a (unintelligible). Winds are always from, they're always goin' to the east. And when they come west, or south, southwest, we can get it, but even what they got in Yakima was (unintelligible). The most they got anywhere was in Yakima, and they survived it alright. I think we have less chance of getting ash here than anywhere, because it goes up from here and then carries it away.

Finally, we include an extraordinary series of discussions by a family who showed involvement, insight, realism and humor. Would that all experiments were so "successful."

First Discussion

Experimenter: Now, based on what the volcano's doing, does anyone want to move at this time?

Husband: No, we're all making money, is that it?

Teen: You bet.

Husband: So, is this realistic, though?...What kind of business are you in? Widgits?

Teen: (unintelligible)

Husband: But you're just making money and you don't care. I'm sure this is one of the things that, that if, in real life, we'd have to think about.

Teen: Oh, definitely.

Experimenter: [illegible] think about it in real life.

Teen: But, you don't know, it depends on what we're selling.

Husband: Well, the only thing is, if the people move out of the area, if you're in a business where you'd have to move stuff out, and you're not selling locally, uh, that's ok, but if you're selling to people in the area, then we really would have a problem. See, that's one of the things that you've got to come to grips with. But you really think that we shouldn't move.

Teen: Well, see, it all depends on what we're selling. If we're selling shovels...

Husband: Well, ok, yeah.

Teen: Do we need a (unintelligible), we're doin' alright.

Husband: (unintelligible) thanks for the ash, Ok, but seriously, we didn't move anyway, we just kept right on trucking.

Wife: That's right. I don't think we'd move, because I don't think our...

Husband: It's too big of an investment.

Wife: Right. And not only that, but maybe what we were selling would only be good for this area, whether the mountain blew or not.

Husband: Well, what you're saying is is that the ash is temporary, and we'll overcome it.

Wife: Right.

Husband: Which is speculative.

Teen: I mean, when the mountain, you know, when it was growing by two feet, and then they said an eruption was imminent, I was still making money, so I figured whenever I was doing real good business, I was going to still...

Husband: Ok, well, this gives us a fine line, though, between the game and what you got to lose if you take people who have produce or something, where they stand to lose 50 or 60 thousand dollars.

Teen: (unintelligible)

Husband: Or they're sitting on the banks of the Cowlitz.

Wife: But in reality, most of the people, even when the ash did finally land...

Husband: They stayed.

Wife: And the people did stay, and they found out that the ash by far (?) a very bumper crop. (Unintelligible) they had a bumper crop.

Husband: One of the things that everybody around here really came to grips with was the idea that they'd weather it out, that since they were not drastically affected right now, they'd just see what, what everything...

Teen: I think most people just stayed around here, so I don't think...

Husband: Ok, so our decision is that we're going to stay.

Wife: Oh, I think so, because I think it would be wrong to get up and move just because of one setback or one thing, I mean, that's not, that's not us.

Husband: A minor cubic mile of ash.

Mother: Yeah, you know, heck.

Teen: I mean, it's, you know, how often is it going to do this?

Husband: Just be glad you don't mow lawns at WSU.

Wife: That's right. But the thing to think about too is that wherever you moved, you know, you'd have tornadoes, and even more likely to have hurricanes and tornadoes than you are to have the mountain constantly erupting.

Husband: Ok, the mountain is a known quantity. Chances are the wind pattern, 95 percent of the time will go away from us. The other thing is, fear of the unknown, pluswhere are you gonna go. There's too many ifs and unknowns about moving. Ok.

Wife: And I think, I think we're still better off staying, because I don't want to end up with hurricanes, and I don't want to end up with tornadoes.

Experimenter: Ok, do we have a consensus?

Husband, Wife, Teen: Yes, we're staying.

Second Discussion

Experimenter: How do you guys feel about moving?

Husband: We're busy making money, I think.

Teen: Well, I don't know, they're directing it now, I don't know. The dams have held up so far.

Wife: Oh heck, we lived through the '48 flood.

Husband: Until it really affects people directly, that is, it goes right into your back yard, I think people are going to evacuate only as a last minute thing.

Teen: Well, like, you know...

Husband: Take precautionary measures.

Teen: Like the people in Castle Rock or probably Lexington, where they had floods before, they're probably, you know, they're the ones that are...

Husband: Many people have.

Teen: Most of the floods, you know, if they survived this flood, I don't think they are going to leave.

Husband: Ok, basically, the people may have shifted to higher ground, but many have not left the area. Therefore, the market's still here, and the stuff is still here.

Wife: Well, most of the people though, alot of the people moved from Castle Rock to Longview just to stick around, so they haven't left the immediate area.

Husband: The amount of work that the Corps of Engineers has done in building up the dike, I think it's been fantastic. So...

Teen: Yeah, we drove by there, you could even see where it's just...

Husband: This huge wall.

Teen: As far as you can go, you know, it's just like (unintelligible)

Wife: I just, I think even, I think because we even talked about it, I don't think...I'd stay.

Teen: I want to make some more money. (Laughter)

Wife: Well, where would I go? No, but it wouldn't even be making the money, it'd be the fact that where we go...

Husband: The thing is, it's survival. If you move, one, you have to close down everything, you have to figure out how you're going to move it.

Teen: Plus you gotta sell it.

Husband: There are less problems with staying than there are moving.

Teen: Plus you know, plus you have to get out of the mortgage and stuff on your business, you got to sell it to somebody.

Husband: Well, you can always pull it with you, but the idea is you're better off.

Wife: And then relocating...

Husband: ...trying to see what you can do.

Teen: And then where would we relocate?

Wife That's right, and where would your business be just as good and would your employees go, you've got good employees, and then if you did move you'd have to retrain if your employees wouldn't go with you.

Husband: Toilet seats will always sell.

Wife: Oh, god, alright, this family wants to stay. Toilet seats!! Marketable product...

Third Discussion

Husband: I don't think things have still made me change. My original feelings are exactly the same.

Teen: You know, it's getting worse though. That's, that's the only thing that we ought to start to think about. But I'm not ready to move yet.

Husband: Well, I think most have considered it a nuisance until it affected their lives, like remember when it actually fell, it was very depressing, and we all wanted to get out of the area for a while, but we really, you know, we weren't ready to pack up.

Teen: No, you don't want to leave your house.

Experimenter: You were thinking about a more temporary leave then?

Husband: Yes. Well, when the ash fell on us here was Sunday, and it just was really depressing. I mean...

Teen: It was gray and floating around...

Husband: Looked like you were watching an old sepia movie.

Wife: It was wet...

Husbnad: It came in with the rain.

Teen: It stuck to everything.

Wife: Yeah, it was just, you know, that's the whole thing that was so kind of depressing, that it was just, you know, everything was gray and awful colored.

Teen: You know, plus there was just (unintelligible) a week before and I don't think people were ready for it.

Husband: But I think one of the things that gear people's thinking, I can even see and hear, and I must be thinking the way other people thought. It's a nuisance, it's temporary, it isn't going to last forever. If I was sitting on the east side, if I was sitting over in Yakima, and I could look forward to a shot about every time that thing blew its top, then I might be in a different situation, but not here.

Experimenter: ... should I type in that you don't want to move?

Husband: We don't want to move. Well, I think that's the consensus.

Wife: Yeah, we don't want to move.

Fourth Discussion

Teen: Can we talk about it? You gonna stick around or are you gonna close down production or what?

Husband: We never close. (Laughter, something unintelligible)

Teen: Are you sure?

Husband: I'm sure.

Teen: Mom, what are you going to do?

Wife: I think I'm going to continue because even with the massive flooding, people are still going to need to buy, they're still going to need some...

Teen: Not toilet seats?

(All laugh)

Teen: Well, what are you going to need a toilet seat for?

Wife: No, no...

Teen: Loading down the (unintelligible), right?

Wife: Yeah, you're right.

Husband: Ok, what are we going to do? You want to sell out?

Wife: No, I'd never sell out. Why?

Teen: Well, they've built up the dikes now, so that's going to help the flooding.

Husband: Just a gush right down to the Columbia.

Teen: Plus the production's keeping up, so we can't stop now.

Wife: The thing is though, it's just like when we had the first eruption, it's just like [person's name] said, that by the school's going back, it brought people back to normalcy.

Teen: (a few words unintelligible)...the eruptions were getting worse.

Wife: But that's alright, they're still going to...

Teen: But what happens when it's you know, when the winds start to change. What was the date on that anyway?

Experimenter: May 18th?

Teen: May 19th?

Husband: Yeah, see, and...

Wife: That's still not going to make any difference.

Husband: My immediate decision is to say stick with it.

Wife: I would say...

Teen: We're still making money.

Wife: Yeah, and the thing is that, what we're selling on a daily basis...

Husband: The economic is driving it, is that right?

Teen: You know it.

(All laugh)

Husband: Well, that is a way, and that's what people want to find out.

Teen: People are still buying, so I guess whatever we're selling, whether it's toilet seats or...

Wife: But no matter what, people aren't gonna just get up and go like that, 'cause you know people are still making a decision, because they have their homes, their businesses, they have schools, and where are they gonna go?

Husband: There has to be some reasons for staying or going. The reasons for moving are, obviously, you think you're gonna get wiped out. But that's an iffy thing. The things for staying are that you do make money, and there is less things to do if we stay, plus worries, so for me, I vote to stay.

Wife: I'm voting...

Teen: Plus where would we get a job and stuff?

Wife: And your schooling, you know, and in my...

Husband: Well, right now he's running a business, see, you've got to put yourself back into...

Wife: Ok, but...

Teen: (a few words unintelligible) families, though. Where are your kids going to go to school? You know, all your friends are...

Husband: What are you going to do with the business if you book now, because who's gonna pick it up? Only somebody with a lot of money who's going to come in and just pick it up for peanuts. I'd much rather stick with it.

Wife: Oh, me too, because I think it would be foolish, because there are too many problems in moving right now. And who's going to be scared of a little flood? I keep telling you, the dikes held in '48, and what's to say that they're not going to hold now?

Husband: You remember the dikes in '48?

Experimenter: Everyone wants to stay, right?

Husband: Right.

(Experimenter announces that the experiment is over when game resumes.)

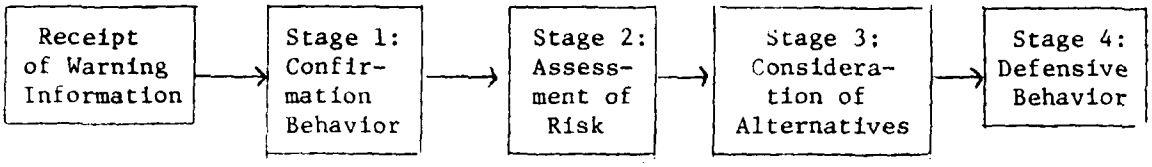
Chapter Seven

IS THERE A SINGLE MODEL OF RESPONSE?

The data presented in Chapters Three through Six tell more than one story. On the one hand, results consistently show evidence of stress due to a considerable amount of negative experience with Mt. St. Helens. In contrast, both experience and stress vary within families, across families in the same location, and across locations. It is by no means evident that there is a single theoretical explanation behind the diversity of relationships between experiences, stress levels and decisions.

A common approach to integrating the types of data already presented is to develop a linear causal model, or path model. As will be shown, no single path model appears satisfactory. Husbands, wives and teenagers did not perceive or react to the threat of the volcano in the same way. Similarly, residents of the three Washington State sites displayed quite different patterns of response. It would be inappropriate to conclude that no integration of evidence can be achieved. However, it is quite evident that many more questions have been raised by our findings than can be handled by a single model.

To some extent, a similar problem occurred in the Natural Hazards project when data on household response to warnings was analyzed. In general, a single process was envisioned, as shown in Figure 7.1. Essentially the same basic model applied to flash floods, hurricanes and tornadoes, as natural hazard events. There were differences in both the specific variables involved for each type of hazard and in the strength of the various causal paths, however. Details are provided in Kendall and Clark (1981).



From Kendall and Clark, 1981, p. 285

FIGURE 7.1. Stages of the Decision Process Under the Threat of a Natural Hazard

Data from the Mt. St. Helens interviews cover a wider set of variables and are more difficult to subsume in one model, in part because of the intra-familial variability in perceptions and reports of actions. However, some type of conceptual model will be helpful for guiding this attempt to integrate results.

EXPERIENCE AND RESPONSE

Three separate areas of theoretical interest are encompassed by the data. The first area contains the set of variables pertaining to family experiences, perceived threat, search behaviors, constraints to protective action, and actual protective action. Because location affected most of those variables, and is an indication of proximity to the mountain, proximity should be added to the variable list. A conceptual model of these variables appears in Figure 7.2.

There are important differences between the model in Figure 7.1 and that in Figure 7.2. First, although many people were aware of the volcano "acting up" for about two months prior to the main eruption (Greene, Perry and Lindell, 1980), there was no official warning preceding that eruption.

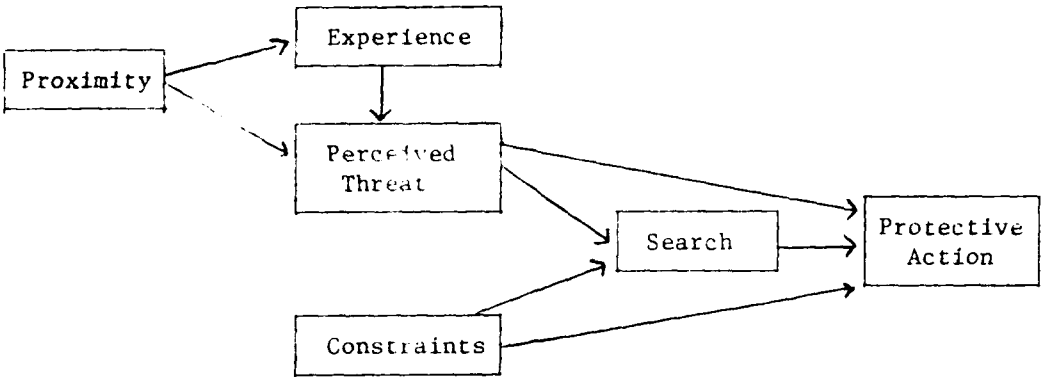


FIGURE 7.2. Conceptual Model for Protective Action

Consequently, there is no Receipt of Warning Information block in Figure 7.2. The Experience block in Figure 7.2 is the nearest equivalent, although very different from a warning. Proximity was not relevant to the Natural Hazards research, since all sites were where the event occurred.

Secondly, the Natural Hazards model indicates that Confirmation Behavior (confirm that a threat existed) follows upon receipt of a warning. For people subject to Mt. St. Helens' eruptions, no confirmation is needed. The Experience block in fact overlaps with some of the Confirmation Behavior variables from Figure 7.1.

Perceived Threat in Figure 7.2 is essentially the same as Assessment of Risk in Figure 7.1, although measurement procedures and some aspects of meaning differ between the two. The Natural Hazards data concerned assessing risk in advance of a single event, such as an approaching hurricane. The Perceived Threat data from Mt. St. Helens concerned the chances of continued volcanic activity and the likelihood that it would threaten the family.

The latter, therefore, implied both a factual, recent experience basis, the May 18 eruption, and a conjecture about the future. The Natural Hazards risk assessment was purely conjectural. In fact, some data from the Mt. St. Helens interviews suggest that, after weathering the May 18 eruption, people were able to feel some confidence that they could manage future eruptions. Such a phenomenon is not uncommon in research on natural hazards.

A third difference between the conceptual models is the inclusion of constraints on action in Figure 7.2. If families perceived a move to be too costly for any of a variety of reasons, then actually moving in response to the mountain would appear to be out of the question. Since more temporary defense behaviors were the focus of the Natural Hazards questions (taking shelter or temporarily evacuating), comparable constraints did not apply.

The balance of the figures is parallel. Search behaviors for the Mt. St. Helens interviews are similar to, but cover a broader set of options than Consideration of Alternatives in Figure 7.1. Final Action, again, is similar except that moving permanently was not a focus of the Natural Hazards studies.

The point of the preceding comparison of conceptual models is that there is continuity between the Mt. St. Helens project and previous work, despite important differences in the nature of the hazard being studied. Certain differences, however, highlight the difficulties inherent in attempting a statistical solution of the conceptual model. Specifically, members of the same family disagree about objective events and register different levels of concern about future events. In addition, families in the different locations studied had quite different experiences and were under rather different types of threat for the future (e.g., ash versus flood).

For these reasons, a single path model solution of Figure 7.2 will not be attempted. Instead, certain continuities in the data will be indicated, as well as major discrepancies. Since there are three age-sex roles by three sites, or nine possible data sets to examine, we will concentrate on the most vulnerable site: Longview-Kelso.

Did experience influence perceived threat? There are two summary variables for experience: "family had it" and "others had it." Also, there are two threat variables: the chance the mountain would continue to erupt and the chance that, if it did, it would threaten the family's health or property. Therefore, there are four correlations of interest.

For the Longview-Kelso husbands, none of the four correlations between experience and threat is large, and none approaches significance. For the wives, only one correlation is sizeable, though not significant. The "others had it" score correlates .32 with perceived threat to the family if the mountain continues erupting. Teenagers show slightly larger correlations between that threat variable and both "had it" scores (family had it: .36; others had it: .40, $p < .1$). The significance levels are hampered, of course, by the fact that only 20 families are involved.

Apparently, then, only wives and teenagers connect any of their experiences to their concern about the future. Why husbands do not is a mystery. We turn next to whether search behaviors relate to threat and constraints.

For husbands, both threat variables correlate with their reports of search efforts (continue erupting: .27; threaten if erupt: .33). The comparable correlations are .15 and .03 for wives and .01 and .06 for teenagers. We know, of course, that members of the same family disagree both on the threat variables and on their perceptions of search activities. Apparently only husbands perceive these as related aspects of response to the eruptions.

Regarding the relationship between search behaviors and constraints, we find exactly the opposite pattern. Husbands report no relationship ($r = -.02$) whereas both wives and teenagers do ($r = .25$ and $.26$ respectively). There is at least a hint of an unintended division of labor in these data. If husbands contribute to (admittedly, we only measured perception of) search efforts according to perception of risk, and wives and teens contribute according to perceptions of constraints on alternative actions, then a more thorough basis for search exists than would be indicated by any one family member. This is a highly speculative inference, of course, but it may warrant future inquiry into the dynamics of family response.

Finally, does reported family action relate to risk, constraint or search? Regarding the correlation of action with risk, we find only very low coefficients for husbands, with wives and teens both indicating some correlation between the chance the mountain will continue erupting and the family's actions ($r = .29$ and $.30$ respectively). Only the teenagers indicate a relationship between action and constraint ($r = .32$).

The single action score used here combines actual evacuation, discussion of evacuation and discussion of moving permanently. Since constraints pertained to moving only, it is not surprising that there is little relationship. As noted in Chapter Four, teenagers say they were involved in decisions (hence discussions) more than their parents say they were. Also, teenagers presented different priorities for constraints on family action. Their correlations, then, may well reflect their different and only partly acknowledged contributions to the family decision process.

The remaining linkage is that between search behaviors and actions. Here the data are consistent and significant. The correlation for husbands between search and action is .48 ($p < .05$). Comparable correlations for

wives and teenagers are .65 ($p < .01$) and .57 ($p < .01$) respectively. Thus, despite many moderate and contradictory relationships for the paths in Figure 7.2, all family members agree: action is strongly related to search behaviors.

Those relationships obtain for Pullman and Yakima as well, though less strongly. In fact, the Yakima relationships are much lower (.21, .29 and .11 for husbands, wives and teenagers, respectively). Not only is the proximity effect evident, but so is the nonresponsiveness of the Yakima sample. If relatively little action is taken, it cannot be highly correlated with anything.

STRESS AND COPING

A conceptual model for the data on stress and coping begins as did that in Figure 7.2, with experience and threat indicating the potential for producing stress. Three aspects of stress need to be incorporated: life events stress scores, stress graph levels and dyadic correlations from the stress graphs. Since the graph material can further be sorted into different time periods, the variable system is potentially quite complex. Coping will be represented by the single scale of related coping items reported earlier.

Figure 7.3 presents a model relating these variables. Because the Proximity, Experience and Perceived Threat links have already been discussed, attention will be focused on the stress and coping variables.

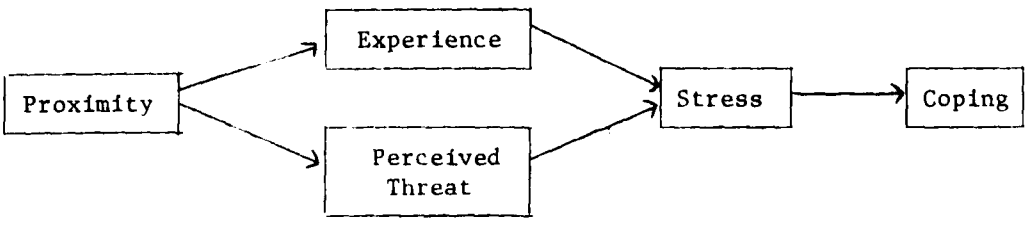


FIGURE 7.3. Conceptual Model for Stress and Coping

If a formal statistical solution for the paths of Figure 7.3 were to be sought, then the life events stress score prior to May 18 should be displayed in the diagram as Prior Stress, and treated as an exogenous variable. The life events stress score after May 18 would then be used for the box labeled stress in the diagram, with an input arrow from Prior Stress. For less formal exploration, however, it will be preferable to use a single difference score to represent the life events items. That difference score, Stress Change, is the post-May 18 score minus the pre-May 18 score.

As in the previous section, only Longview-Kelso data will be examined in detail. A thorough report on all sites and age-sex categories would be exhausting. Also, we will focus attention on the period immediately around the May 18 eruption, which was represented by data points 1 through 10 on the stress graph.

Was stress related to experience and to perceived threat? The first variable to be examined is stress change, or the increase (decrease) in stress after the May 18 eruption compared to the prior level, based on the life events scale. For both husbands and wives, very little relationship between stress change and either of the "had it" scores appears. That lack of correlation is reasonable, in that there is very little overlap between the life events items and the volcano experience items. Teenagers do show a sizeable correlation ($r = .38$, $p < .10$) between stress change and the "others had it" score. Either this result is a statistical accident or it implies that the teenagers' awareness of problems around them colors their perception of family problems or vice versa.

A striking relationship appears for both husbands and wives when stress change is correlated with the perceived probability of future eruptions. Those correlations are $r = -.54$ ($p < .05$) and $r = -.47$ ($p < .05$) respectively.

Teenagers show a trivial, positive relationship. Why would a threat item correlate negatively with change in stress? The most plausible interpretation is that some people anticipated a major eruption and future eruptions as well. We do not have the former information. Nevertheless, if prior and subsequent predictions about the likelihood of eruptions are autocorrelated, then we can deduce that adults who experienced sizeable increases in their life events stress scores were those who did not anticipate the May 18 event. Those who were mentally prepared did not evidence increased stress scale scores.

For husbands and teenagers, there is a positive relationship between the stress change apparent in the life events scores and the degree of elevation shown in the stress graph for the first 10 data points (April and May, 1980). The correlations are .33 and .26 respectively. Oddly, wives show a -.20 correlation. The positive correlations suggest that the changes in life events scores were in fact affected by the mountain, the effects of which are apparent in the graphs. The smaller negative relationship for the wives is not consistent or readily explained.

One other sizeable discrepancy between family members appears in the correlations between stress change and coping. For husbands, stress change correlates .37 with the coping scale. In contrast, wives show a -.31 correlation between stress change and coping. Teenagers show a small positive correlation. It should be remembered that the coping items were worded in terms of change, so the scales should be parallel.

Again, it is possible that the results are accidental. Neither correlation is significantly nonzero, although they are certainly significantly different from each otner ($p \sim .02$). A speculative explanation of the data could undoubtedly be manufactured, but that temptation will be avoided until further evidence can be obtained in the future.

The stress graph data produced both individual stress levels (compared to overall stress) and also the family scores based on dyadic correlations. Especially for the period of April and May (points 1-10 on the graph), these two measures are highly correlated. For husbands, wives and teenagers, respectively, correlations between individual stress levels at the time of the eruption and family scores at the same time were .59 ($p < .01$), .48 ($p < .05$) and .48 ($p < .05$). Obviously, these correlations are lower at later times, when the effects of the mountain have dissipated.

Husbands, only, show a moderate negative correlation between their April-May graph scores and their predictions of future eruptions ($r = -.25$). Such a correlation is in keeping with the earlier finding regarding the life events scores. However, neither wives nor teenagers show a relationship. Similarly, husbands show a modest correlation between their graphed stress at the time of the eruption and their report of family experiences due to the mountain ($r = .23$). Again, wives and teenagers do not show even moderate relationships.

Both husbands and teenagers do show a positive relationship between graphed stress levels and the coping items. Correlations are .24 and .43 respectively. Again, wives' data show little correlation. In sum, then, the husband data suggest that the graph taps a linkage between an unanticipated eruption, elevated stress (both graph and scale) and subsequent coping. Teenager data support the last portion of that linkage, but wife data do not support such a causal path.

Finally, correlations between the family scores and other variables are quite chaotic. It is necessary to recognize, of course, that the family score does not measure stress itself, but the extent to which family members show a similar over-time pattern of response to stress. It is likely that the

family scores would relate to the content of the family's interaction about whether to evacuate or move, but we have no data on that content.

EXPERIMENTAL VARIABLES

The final area of theoretical interst is the simulation experiment behavior as it relates to other aspects of the family's experience. If there were direct correspondence between the way people behave in simulations and the way they behave in reality, then a conceptual model could be developed as shown in Figure 7.4. As with Figure 7.2 and 7.3, the first portion of Figure 7.4 concerns actual aspects of Mt. St. Helens' activity. To the extent that the game behavior is influenced by experience with the mountain, both the individual decisions to close down the plant and the individual preferences about relocating should be influenced by experience and perceived threat. Of course, threat is present in the simulation, but it is constant for everyone from the same location. Thus we are observing a real-life effect imported to the experiments if experimental behavior correlates with the other factors within the same site sample.

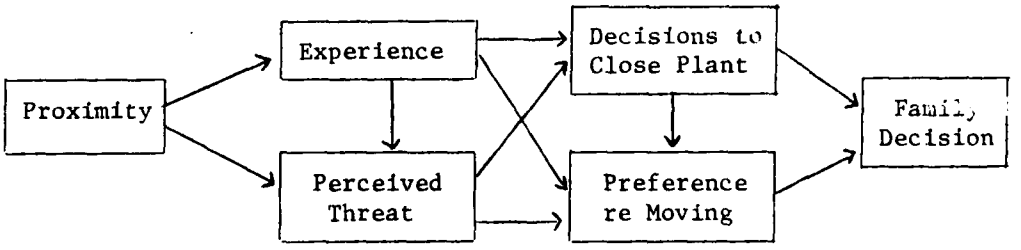


FIGURE 7.4. Conceptual Model for Experimental Actions

Again, only Longview-Kelso data will be examined. As usual, there are some notable differences by husbands versus wives versus teenagers. All three age-sex groups show a negative correlation between family experience (the family-had-it-scale) and whether they had closed their plant down by the end of the fourteenth and most threatening period of simulation. Correlations are husbands: -.09; wives: -.45; and teenagers: -.22. A similar pattern obtains between family-had-it and the individual's preference for the family to move at the end of that most serious eruption scenario. Correlations are -.09, -.33 and -.28 respectively.

Although the husband correlations are trivial, those for wives and teenagers suggest a fairly sizeable tendency for people whose families experienced real problems to prefer a tougher stance in the simulation. That sounds suspiciously like the well documented tendency for "old hands" in hazard-prone areas to resist evacuation or taking shelter, compared to newer residents who are unaquainted with the particular hazard.

The family decisions to move show a similar but weaker tendency except for the teenagers. Correlations are husbands: -.18; wives: -.14; and teenagers: .43. This teenager correlation is accountable only to the extent that prior data raised questions about teenager accounts of what experiences the family had with the mountain. The family decision in the simulation is, necessarily, the same for all members. Therefore the change in correlation reflects discrepancies between the parents and the teenagers regarding family experiences.

Neither husbands nor teenagers show any link between their simulation behaviors and their assessments of risk from the volcano (future eruption and family threat if eruptions occur). Wives, on the other hand, show both close-down behaviors and preferences for moving which correlate with their estimation of the chance of future eruptions. Those correlations are .38

and .27. It will be recalled from Chapter Four that wives showed more overall concern about the volcano. That concern appears to have influenced their performance in the simulation.

Finally, do individual actions and family decisions within the simulation experiments show interrelationships? They most emphatically do. The relationships between close-down and move preference are husbands: .68; wives: .72; and teenagers: .79. All are significant at the .01 level. Similarly, for close-down and family decision, the correlations are husbands: .56; wives: .72; and teenagers: .57. All are significant beyond .05. Finally, the move preference and family decision correlations are husbands: .86; wives: .72; and teenagers: .72. All are significant beyond .01.

It is clear that behavior in the simulation was highly consistent, at least by the end of the fourteenth period. Also, it would appear that husband's preferences exerted the strongest influence on family decisions. That result would not be surprising, based on very extensive small group and family decision making literature.

One final, fascinating piece of evidence concerns how well the simulation decisions reflect actual family actions in response to Mt. St. Helens. Again only for the Longview-Kelso samples, whether the family moved in the simulation was correlated with the family's protective action score for the May 18 eruption. For husbands and wives, respectively, those correlations are .41 ($p = .07$) and .59 ($p = .01$). By contrast, the teenager correlation is .02. Again we find evidence of gross discrepancies between parents and teenagers. Perhaps we should just smile and accept the inevitable.

SUMMARY

Only one site was examined in detail: Longview-Kelso. Differences exist between the sites that make simple summary statements virtually impossible. By choosing the most threatened site, we should be better able to discern the extent to which diverse aspects of the data imply a consistent picture. To some extent they do.

It is clear that some satisfactory levels of relationship between variables appear for all three theoretical areas. For wives and teenagers, experience influences perceived risk. For husbands, perceived risk influences whether the family engages in further search behaviors. Parallel to this role-related difference, wives and teenagers report that constraints influence search behaviors, but husbands do not. Again, wives and teens indicate that risk influences family action, and all age-sex groups show strong relationships between search activities and family actions.

This somewhat consistent but contradictory evidence might imply an age-sex (i.e., family role) structured response pattern such that conflicting reports only imply different views of and involvement with a complex process. A more detailed statement at this time would go well beyond the evidence available.

Stress and coping data complement the previous picture. Both husbands and wives indicate that increased stress due to the May 18 eruption is related to not anticipating (or being prepared for) that eruption. Stress graph evidence both corroborates and expands on information from the life events stress scale. However, husbands and wives show opposite correlations between stress scale scores and coping scores. The dyadic-based family scores are clearly correlated with elevated levels of individual stress, indicating that common response to over-time events is likely only when a major event elevates all family members' stress levels.

The experimental simulation evidence not only indicates clearly consistent behavior within the simulation, but also links that behavior to certain real world data. Most promising is the strong correlation between family actions in response to the volcano and family decisions in the simulation. The major cautionary note provided by the simulation data concerns the teenagers. They obviously have provided quite divergent accounts of some of the real life aspects of living near Mt. St. Helens.

Chapter Eight

CONCLUSIONS AND RECOMMENDATIONS

If a study such as this is worthwhile, it will have accomplished at least a portion of the following: corroborated existing evidence, provided new insights, advanced existing methodology for conducting such research, or provided a basis for more effective public policy. To some extent, we have done all of these. Yet the analyses presented have been somewhat less sophisticated than current procedures enable, in part because patterns of relationships in the data vary across study sites and across different members of the same family. A single, formal model accommodating all data would be quite complex and difficult to develop, due to the relatively small number of cases and the large number of variables. Such development may be an important task for the future. This report, in contrast, has emphasized simple presentation of the separate parts of a complicated mosaic.

A brief overview of major findings is appropriate before considering whether there are any useful lessons in the data. Following that overview, we will make some observations which do not depend on formal research procedures. Somewhat by chance, while making contacts in the field, we discovered some important problems in how the Mt. St. Helens threat was handled. After those "field notes," we will conclude with seven recommendations for future research and public policy.

OVERVIEW OF FINDINGS

Two types of data gathering were used, in three Washington State sites and one control site. Random samples of households were interviewed by telephone, one respondent per household, approximately six months after the May 18 eruption. These telephone samples were re-interviewed about six

months after the first interview. Telephone samples were drawn only for the Washington State sites. In addition, a smaller sample of families was interviewed face-to-face in greater detail. Husbands, wives and one teenager per family were interviewed. Then the families participated in a computerized game simulation experiment regarding reaction to a worsening Mt. St. Helens scenario. Half of the families were re-interviewed about six months later.

Total numbers of cases were 152 first-wave telephone interviews with 138 follow-up interviews. Sixty three-person face-to-face interviews were conducted in Washington State and 10 control family interviews were conducted in Minnesota. Thirty follow-up three-person family interviews were conducted in Washington State only. The sites in Washington State were Longview-Kelso, Yakima and Pullman, providing an approximate geometric progression of distance from the mountain. All are small cities, with Yakima the largest.

Demographic evidence from both telephone and family interviews shows reasonably representative households for the middle years of the family life cycle. The sampling criterion of intact families with at least one teenager necessarily eliminated very young and very old parents, as well as single parent families, isolated individuals and various types of pseudo families. As might be expected from a university town, Pullman families have many more professional occupations than do the other sites.

The strongest indication throughout the data is that the May 18 eruption created considerable stress, especially for those near the mountain. Both the life events stress scores and the stress graphs evidence increased stress. There is a fairly clear distance gradient in the effects, such that Longview-Kelso residents indicate the highest levels of concern, with Pullman lowest of the Washington State sites. Not only did stress levels change, but so did a variety of coping behaviors. Most of the coping appears to be

positive, such as increased social activities, being thankful, believing in God, and so forth. To some extent, the coping patterns correlate more highly with knowledge of others' problems than with one's own family's experiences.

There is indication also that the stresses created by the May 18 eruption have not abated entirely. Especially for Longview-Kelso residents, where flooding of the Cowlitz River can pose severe threat, there continues to be a wary attitude toward the mountain and how it has influenced the river. This problem is somewhat lessened by the extensive, round-the-clock efforts of the Army Corps of Engineers to dredge volcanic sediment and accompanying mud from the river and to create miles of dikes to control high water levels. The winter of 1980-81 was remarkably low in precipitation in that area, so that flood risk was avoided. This winter (1981-82), on the other hand, appears to be much wetter already. It remains to be seen whether serious flooding is yet to occur.

In addition to stress and coping data, our results indicate relatively low levels of attempting to do anything to get away from the threat of the volcano. Not may families evacuated, only in Longview-Kelso did many even discuss evacuating, and very few discussed permanently leaving. Sizeable proportions of respondents indicated that a permanent move would pose serious difficulties in terms of work (primarily the husbands), a place to live (mostly wives), and friends and schools (predominantly teenagers). Estimates of costs of a permanent move varied wildly, with little indication that people in the same family saw the problem of moving in similar terms.

In short, families apparently do not seriously consider moving away from a severe and continuing natural threat. We do know that some families moved, of course. Yet some of those interviewed flatly stated that there was no chance of their moving, and most assigned a low probability to such

an action. Given the high degree of residential mobility in this country, that level of unwillingness to move may seem surprising. Normally, though, people move to obtain a better job, a better residence, a nicer neighborhood, and so forth. To move away from a threat is quite different from moving to an opportunity.

According to our data, then, the residents affected by Mt. St. Helens will for the most part continue to live where they are and continue to be apprehensive about the mountain. Many indicated that they could not sell their homes, and about 90 percent are homeowners. Neither could they tolerate the lost equity if they simply abandoned their homes. To some extent, they are in a bind from which there is no reasonable exit.

In addition to the evidence just discussed, we also were able to demonstrate, by use of the stress graph, that families show similar over-time response to stressors only under a major threat, such as the volcano. At other times, unique stress events appear but do not necessarily evoke comparable response from members of the same family. An unanticipated benefit of the stress graph is that it generates a much wider set of stress events than standard life event stress scales contain. In many respects, the stress graph promises new opportunities for studying both individual and family-level reactions to external stressors such as major natural disasters. It will also help document that, for many people, the stress remains long after the event is over.

Finally, experimental simulations involving members of the same family have shown considerable promise in three ways. First, decisions in the simulation appear to be quite strongly correlated with actual family decisions and actions regarding Mt. St. Helens. Secondly, an important phenomenon appeared in the decision process: if any family member was doing well in the current location and did not want to move, the rest of the family was

likely to decide to stay despite individual preferences to the contrary. Thus there appears to be an asymmetric influence on decisions to move. One person wanting to leave typically was defeated in the family discussion. One person wanting to stay could often win. There is, in addition, some suggestion that the simulation experience provides both a learning vehicle and an opportunity for discussion that many individuals and families otherwise did not have.

The last point also pertains to the process of being interviewed. Large proportions of our interviewees, both telephone and family, indicated in follow-up interviews that the first interviews had induced them to discuss the mountain more in their families and among friends. The first-wave interviews apparently did not induce major changes in attitude, but they were not intended to do so. It is possible that interviewing, even by telephone, provides a way to stimulate thought about a serious situation. We do know from other research that some form of personal contact is an important inducement to taking protective action.

SOME FIELD NOTES

Two issues which were not addressed in our interviewing became apparent during the field work. These issues pertain only to Longview-Kelso, but have much broader implications.

The first issue concerns official response to the problems of local residents. In the months following the May 18 eruption, many residents of Kid Valley experienced minor earth tremors. Mostly these were sufficient to be felt but not to cause any damage. The first one, on December 9, 1980, was strong enough to knock over a Christmas tree.

For all these reported quakes, seismologists have no explanation. Even the event on December 9 did not register at nearby seismic stations. Consequently, residents who have experienced the tremors have been told a variety of "put down" explanations. For example, logging activities or dynamiting have been suggested. When a tremor occurs at night, that explanation seems less than sympathetic. One federal official, who was not identified by the person providing this information, publicly stated that the residents were silly to think that they had felt earthquakes.

The result of this series of events was increasing suspicions on the part of the residents that officials were trying to hide what actually was happening. In fact, one woman placed an ad in the local newspaper requesting that those feeling tremors call her immediately so that she could try to document multiple reportings as a way of proving that something was happening. One resident was quoted as saying, "We can't all be crazy."

That such erosion of public trust could be allowed at a time of high stress seems astonishing. Yet articles in the Longview newspaper, The Daily News, report citizen monitoring efforts as late as June, 1981, and a public meeting to share findings. We do not have more recent data on this virtual confrontation of the residents with the authorities. We do know that to tell people they are silly, or they must be imagining things, or they are hypersensitive, is to tell them that they should keep their fears and concerns to themselves. That is just the wrong way for people to handle a serious and long-term threat.

We became aware of the tremor problem during routine follow-up interviews with representatives of public mental health clinics in each of the Washington State sites. Because it was possible that the interviews and experimental simulation could trigger emotional problems for people under

stress, we had contracted with those mental health clinics to provide emergency and follow-up counseling services if needed. In fact, such services were not needed, but having them on call was a very desirable circumstance.

As a way of ascertaining any major trends not available in our data, we revisited each of the clinics in September, 1981, well after data collection was completed. All three mental health clinics reported no change in their caseloads over the time following the major and minor eruptions. All clinic administrators stated that Mt. St. Helens was never discussed in staff meetings as a possible stressor of clients. This, too, we found astonishing.

It is important to note some comments by these administrators, in part to verify that they were neither callous nor derelict in duty. One was quite nonplussed during the re-interview. This administrator believed in retrospect that there was a problem due to Mt. St. Helens, in that reflection on personal experience made evident that family tensions had been increased due to the volcano. We were told that it was too bad we had not called about our research much earlier, to remind them that the mountain could be a problem for their cases. That clinic, as with most public clinics, had been working overtime all through the summer of 1980 and simply did not have time to reflect on possible new sources of stress. They were too constantly involved in the more standard types of problems their caseload contained.

Both of the other clinics reported no change in caseload due to the volcano. Yet both also stated that they were at maximum capacity before the eruptions. If the existing cases did not happen to introduce the mountain as a new part of their problem, and if no new cases could be admitted, then there is no way that the eruptions could become part of the caseload picture. In contrast, hospital emergency room visits, especially close to

Mt. St. Helens, showed notable increase after the May 18 eruption (see Mt. St. Helens Technical Information Network Bulletins Nos. 16, 18 and 20).

One administrator was asked if some kind of feelings of guilt might have kept people from seeking help. That is, if everyone is putting up with the same fears and expenses and uncertainties, why do I have the right to seek special help. Such a pattern was thought to be quite plausible, but of course there are no data to demonstrate it. The question did prompt other stories from the person being interviewed about local concerns with the volcano.

In short, no clinic could have handled an increased caseload even if elevated stress levels in the communities called for increased counseling. Public mental health clinics, by virtue of their funding, their staff training and their orientation to individual, unique cases, simply are not prepared to deal with stressors that involve the whole population. For financial reasons, clinics cannot add cases that otherwise would not need help. Stress is typically seen as an individual psychiatric problem rather than a collective problem.

Our conversations with the clinic representatives made evident that a major stressor for an entire population cannot be handled by the usual structure for mental health assistance. That the Mt. St. Helens eruptions were not even considered in staff meetings attests to the work levels already present in the clinics and to the difficulty of changing focus sufficiently to rethink the mental health needs of the community at large. However, the circumstance of continuing stress due to Mt. St. Helens should have been recognized and accommodated. Individual and family stress can be handled well by professional counselors if they have the opportunity to address the

cases and the inclination to recognize their existence following such a major event.

The Longview-Kelso tremor problem makes this lack of mental health assistance even clearer. People were actually being told they should not feel stressed because nothing was happening. To be in danger is bad enough. To be told that legitimate responses are not warranted can lead to more serious problems.

RECOMMENDATIONS

Seven recommendations follow, based on the evidence we have provided. Because the arguments have been provided earlier, no further discussion of the recommendations will follow.

1. The Federal Emergency Management Agency, or some comparable agency, should develop appropriate information materials and public official training procedures to help residents define, confront and express their concerns during and after major natural disasters. Every effort must be made to acknowledge rather than deny public reactions. FEMA's Mt. St. Helens Technical Information Network bulletins provided this type of information, and could serve as a prototype service. However, more attention needs to be directed to public fears and reactions.
2. An emergency expansion of local mental health services should be enabled, with administrators of those centers having explicit involvement in local emergency response plans and specific duties to provide expanded emergency services.
3. Where natural events threaten the lives of local residents, some basis for residential relocation without loss of equity must be

established. Current insurance policies do not accept a need to move and an inability to sell as a basis for reimbursement.

4. Local information centers are needed in the event of such widespread hazards to provide better and more centralized information on ways to cope with the problems encountered, utilize help resources available, and so forth. People are typically reluctant to pursue such information unless it is readily available.

Regarding future research on natural hazards and how people respond to them:

5. Multiple respondent family studies are essential for understanding the complexities of family level responses. Individual respondents do not necessarily agree with other members of their households, and family decisions are not simple consensual processes.
6. More over-time data is needed, especially to distinguish the short-term, sharp response effects from longer term elevated stress problems, and to relate these problems to differential preparedness.
7. Both as a research tool and as a training basis for family preparedness, more exploration of computerized simulations is warranted.

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